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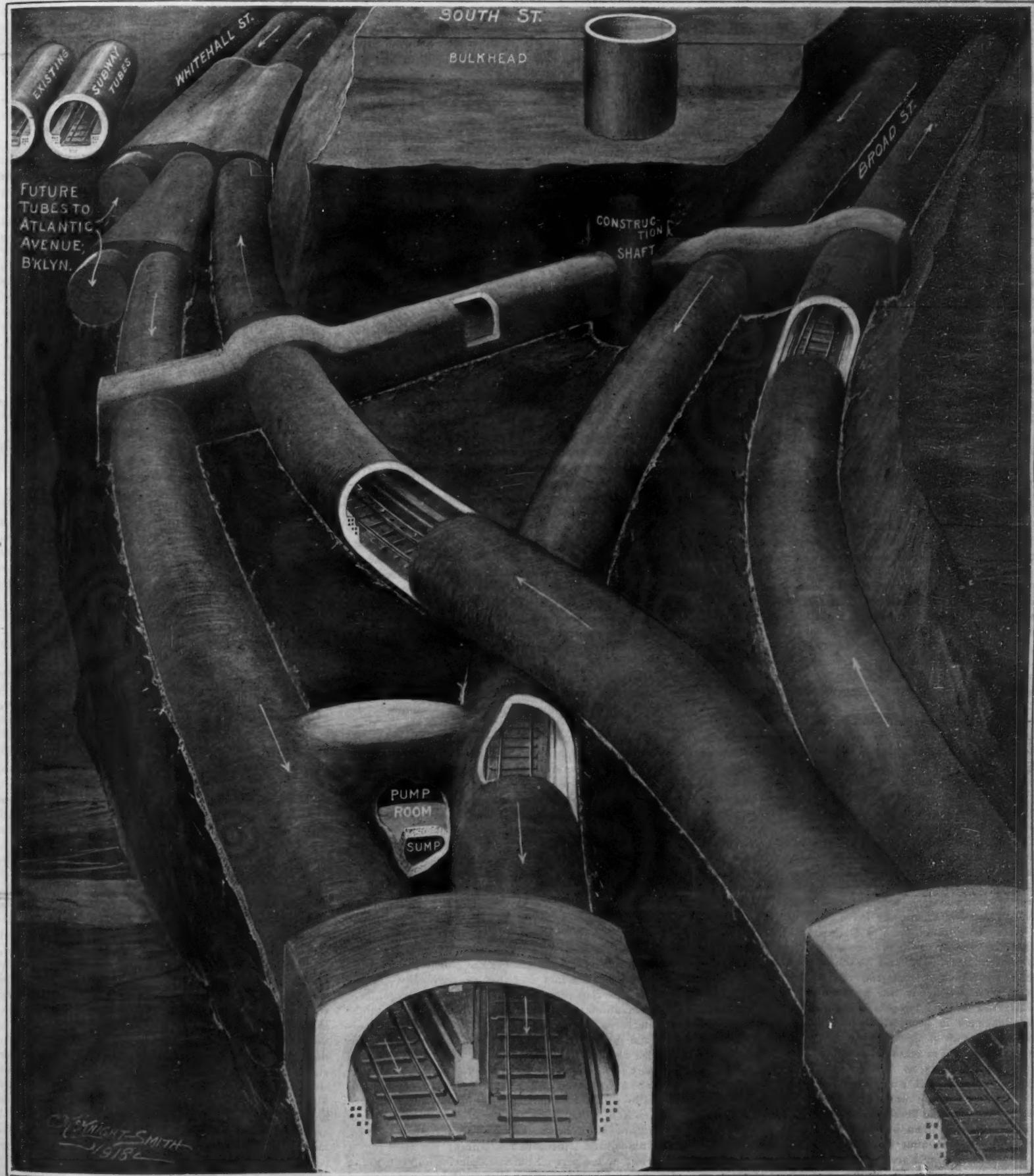
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A network of subway tubes off the end of Manhattan Island [See page 209]

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Women and the Labor Shortage

THE passage of the new Draft Act means that, next spring, we propose to have 4,000,000 men in France and 1,000,000 in cantonments—a truly colossal undertaking. The securing and training of the men is the lesser part of the task; the draft law and the admirable army organization will take care of that. The greater part of the task will be the clothing, equipping and transhipment of these millions of men, and the keeping of them supplied with rifles, machine guns, field guns, howitzers, and long-range guns, shells of all calibers, airplanes, observation balloons, hangers and the thousand-and-one supplies, to say nothing of the food and clothing, which must be on hand in superabundant quantities if this great American Army is to do its share in driving the Huns out of France and Belgium, and winning the final and crushing victories on German soil.

In the last analysis, the problem of equipping and sustaining an army of 5,000,000 men is a question of labor, and already there are unmistakable signs that a serious labor shortage is approaching—if indeed it is not already upon us—which may seriously cripple our military effort, and cause our fulfillment to fall far below our promise. In proof of this we direct attention to the following facts:

The latest official tabulations of labor demands show a present shortage of one million unskilled laborers in war industries, with a tremendous additional shortage coming as soon as the new army draft expansion increases the need for supplies. The skilled labor situation is found to be equally serious. In proof of this consider the fact that Georgia has been notified that unless that state can furnish the \$8,000,000 picric acid plant at Brunswick with five thousand laborers at once, the entire construction force will be laid off and the plant moved out of Georgia. The Employment Service has sent to the various states a statement of the respective quotas of men needed, some for work at home, others to be sent away to other centers.

Now, if our new forces are to be equipped on time, these demands for men must be met, no matter what happens to private business for the time being. The hour for any talk about "business as usual" has passed. The new labor forces required cannot be taken from other war industries, nor can they be recruited from the farms, the railroads, or the mines. The shortage must be met and met quickly; otherwise we shall be confronted by another such disastrous lack of equipment as developed last winter.

The alarming shortage of labor became apparent when the Employment Service put an end to the practise of one plant's stealing labor from another. Previously, if a plant was short, it sent its agents to entice labor away from some other plant by offers of higher pay; and under these conditions the shortage of labor throughout the country was not superficially apparent. The survey of conditions recently completed has laid the fact of shortage absolutely bare.

In view of these facts it is greatly to be regretted that the "work or fight" clause was not included in the recent draft law; and its omission shows that Congress has failed to sense the very serious nature of the crisis with which our war preparations are confronted. There are today hundreds of thousands of able-bodied men engaged in occupations that are not essential to the carrying on of the war, and doing work which could just as well, and in some cases better, be done by women.

And this brings us face to face with the fact that the country is still awaiting some definite call from Washington for the women of the country to enlist in war work. If the President were to send out a strong appeal to the women of America to come forward and fill the ever-widening gap in the labor forces of the country, they would prove that they are not one whit behind their sisters in France and Great Britain in courage or sacrifice.

We know from the lips of the statesmen of those countries that it was the magnificent, the heroic labors of their women that made it possible for the French and British armies to hold the enemy for four bitter years of struggle, and finally, as we see today, to hurl him back in a succession of glorious victories.

Lloyd George has told us that it was the labors of one million women in the munition factories that not only provided the British armies with all the shells they could use, but heaped up such an enormous reserve that the frightful losses of the German drive in March were made good within two or three weeks. He has told us also, that there are between five and six million British women engaged in the various industries concerned in the carrying on of the war; and the same story can be told of the women of France.

In drawing up any scheme for the employment of women we have the broad experience of our Allies to guide us. What they have done, we can do, and because we have the warning of their early mistakes to guide us, we can do it more efficiently and with less friction and dislocation.

Women labor can be used in two ways: directly, in various industries in which they have shown great adaptability; and indirectly, by substitution in work which does not require masculine service. In the former class, to name a few, are the munition factories, the airplane factories, and the plants which turn out the finer grades of instrumental work; in the matter of substitution, women have shown themselves thoroughly capable as car conductors, motormen, taxi drivers, elevator operators, ticket agents, and letter carriers, to say nothing of the manifold work they are doing on the farms.

As to the attitude of labor—the Unions, etc.—we know that the Unions of Great Britain and France, with a loyal faith in the integrity of their Government and of their employers, voluntarily waived their laboriously won rights for the period of the war. It was a fine act of patriotic abnegation. We have faith that American labor will rise to the same level if called upon to make a similar sacrifice.

The labor crisis is upon us. The women of America stand ready to fill the breach; they merely await some definite call from Washington. It cannot come too soon.

Worn Out German Guns

THE frequency with which German prisoners have complained of late that their front line was being exposed to the fire of their own guns, justifies the conclusion that German gunfire is deteriorating, particularly in the matter of accuracy. Loss of accuracy, other things being equal, is directly proportional to the wear of the rifling, or erosion. Of all the causes which diminish the effectiveness of artillery, erosion is probably the most serious. The output of new guns says a General recently from the western front, has not only to provide the numbers required to bring an Army up to the desired strength, but it has to meet the wastage due to accident, to the enemy's fire, and to wear, and he tells us that the last cause of wastage completely overshadows the other two.

We have always known about erosion, which ever since the introduction of nitroglycerine powder has been the *bane noir* of the artillerist. It has taken the present war, with its enormous increase of the use of artillery, to prove how serious may become the wear of guns. Under modern conditions their life is very limited. In fact, experience on the western front has shown that, at the end of a single battle, some of the guns may be so worn as to have entirely lost their accuracy. Erosion, which has been serious even under normal conditions where the firing was more or less intermittent, has become extremely serious under present conditions, where field guns, such as the French 75, can fire as many as 15 to 20 shots a minute, and in cases of emergency may be called on to keep up that rate of fire for long stretches of time. Sustained rapid fire with full charges results in the guns becoming excessively heated. This is being met by the use of reduced charges and the enforcement of strict rules calling for pauses, after a certain number of rounds, of sufficient duration to give the guns a chance to cool. Another palliative has been found in the greasing of the bore with specially prepared substances.

Now for the Germans the peril of this wearing out of the bore lies in the fact that they are extremely short of the raw materials for gun manufacture and particularly for the manufacture of liners or inner tubes. The supply of manganese is becoming a serious problem for the German gun manufacturers, and it is at least reasonable to suppose that the notable decrease in the volume and accuracy of German gunfire is due to the fact that their guns are wearing out faster than they can replace them. If this be so the German high command stands face to face with a stupendous problem; for the long-range shelling of back areas, particularly of shell dumps, cross roads, and concentration points; the silencing of batteries; and, above all the exact placing and controlling of a creeping barrage, or for that matter, of any kind of barrage, all demand that the sights of the guns shall

correspond with mathematical accuracy to the ranges actually covered by the shells. This loss of accuracy keeps pace with the wear of the rifling of the gun and with the enlargement of the bore. Loss of accuracy is due both to the escape of gases past the base of the shell and to the failure of the worn rifling to impart the necessary speed of rotation to the projectile. The rapid wearing out of German guns is one among many contributory causes, which are slowly but very surely bringing the once seemingly omnipotent German army to its knees.

If Spain Went to War

THE sharp diplomatic exchanges between the Spanish and German Governments seem to have resulted in a settlement that is satisfactory to both countries. The situation, however, is pregnant with danger, as indeed in any situation where German good faith is concerned. If the Germans believe that the tide is turning against them in Europe Spain is not likely to be brought into the war; but should German arms be able to stop the progress of the Allies in the west, and particularly should they reverse the present conditions by winning an important victory, we may be sure that Germany will not view with complacency the taking over of her interned ships by the Spanish Government. In any case, it is of interest to estimate what accretion of strength Spain could bring to our cause if she threw in her lot with the Allies.

Her chief contribution would be largely negative, inasmuch as Germany would lose one of the most fruitful fields for her insidious propaganda. Also, and this would be a very positive gain, the task of hunting down and curbing the activities of the U-boats would be measurably lightened. The three-mile limit around the extensive coast of Spain would no longer offer immunity to the hard-pressed German submarines. They would be shut out of her harbors and instead of a too complacent and very questionable neutrality, Germany would be faced by the active opposition of such units of the Spanish fleet as are available for anti-U-boat service. The most important ships in the Spanish Navy are three small battleships completed in 1914 and 1916, which are dreadnaughts in everything but size. These ships are of about 16,000 tons displacement and mount eight 12-inch and twenty 4-inch guns, the heavy guns being protected by 8- and 10-inch armor. The belt is 8-inch, and the speed of the ships on trial was about 20½ knots. Outside of these vessels, the Spanish Navy, so far as its larger ships are concerned is pretty much what it was in 1898; but even at that it includes some vessels like the 7,500-ton protected cruisers "Asturias," and "Cataluna" and the "Reina Regente," which might be used as mine layers or as mother ships.

In her gunboats and trawlers, Spain possesses a fleet that would be of material service in the Mediterranean for mine sweeping and patrol work. There are about 30 of these, which would be useful in keeping clear the entrances to her ports and the passage through the Straits of Gibraltar.

Also the fleet includes some half dozen destroyers of from 400 to 450 tons displacement, which have a designed speed of 28 to 30 knots. These boats were built some twenty years ago.

Exceedingly valuable for patrol work in the Mediterranean would be the 30 or 40 torpedo boats of a little under 200 tons displacement and 26- to 31-knot speed, which have been built during the past few years for the Spanish Navy. The torpedo boat has come into its own for patrol work off shore and in the more sheltered waters.

National Committee for Mental Hygiene

THE last report of the Rockefeller Foundation states that since 1915 the National Committee for Mental Hygiene has conducted surveys in 12 states of the methods of public care of the insane and feeble-minded, besides carrying out demonstration studies of abnormalities in particular communities and especially of the mental characteristics of criminals. "The public attitude toward mental maladies," says the report, "is still affected by superstition and ignorance. The persons in charge of state and county institutions and the attendants are too often conventionally-minded, untrained, sometimes indifferent, even brutal." State hospitals are in many cases quite inadequate. The activities of the committee have already yielded striking results. In one state, a month after the survey was made at the governor's request, the legislature voted half a million dollars for rehabilitating and modernizing in management the state hospital for the insane. Another state, last year, appropriated \$600,000 for carrying out similar reforms, according to a plan formulated by Dr. T. W. Salmon. At Sing Sing prison the committee has investigated the personal histories and the mental and moral characteristics of 600 persons admitted to the institution during a period in 1916-17. A very large percentage of these prisoners were found to be mentally abnormal—a fact that indicates the need of modifying contemporary methods of dealing with criminals.

Naval and Military

New Gun Plants for the Army.—Fifteen of the sixteen Government gun plants for forging and machining cannon have been completed and the sixteenth is about 95 per cent complete. This represents an expenditure by the Government of \$35,000,000. All of these plants are building cannon or cannon forgings for mobile artillery ranging from the 1½-inch anti-tank gun to rifles of 10 inches bore. In addition to these plans, the United States Steel Corporation has under way a \$30,000,000 plant for the manufacture of siege guns.

Compulsory Camouflage of Ships.—The Government has made the camouflaging of ships a military necessity, and the method in which the camouflaging is to be done will hereafter be determined by the Navy Department, which will draw out the designs for different types of camouflage painting; and in particular cases, as far as is practicable, will design the camouflage painting for individual ships. The designs will be made at headquarters and will be sent out to the district camoufleurs through the Camouflage Section of the Division of Steel Ship Construction, Emergency Fleet Corporation.

Gun Erosion.—Prof. H. M. Howe draws attention to the fact that many points connected with the erosion of guns were rendered intelligible by a consideration of the iron-carbon diaphragm. It has long been known that the interior surfaces of a gun became hardened on firing, the effect being perceptible even after as few as five shots. Prof. Howe believes that this hardened layer is not due to carbonization of the metal, but is merely a result of heat treatment. The liner of a 14-inch gun has been worn out by 170 shots, and therefore, the total effective working life of this gun was only about 3.4 seconds.

Composition of the Anti-U-Boat Fleet.—Some interesting figures have lately been published showing the relative percentages of the Allied fleets that are engaged in anti-U-boat warfare. It seems that in the Eastern Atlantic 80 per cent of the vessels are British, 14 per cent American and 6 per cent French. The submarines engaged in the same waters are 78 per cent British, 17 per cent French and 5 per cent American. Of the miscellaneous patrol craft, made up of yachts, motor boats, etc., 86 per cent are British, 11 per cent French and 3 per cent American. In the Mediterranean 38 per cent of the destroyers are French, 27 per cent British, 26 per cent Italian, 7 per cent Japanese and 2 per cent American. Of the submarines, 50 per cent are Italian, 30 per cent French and 13 per cent British. Of the miscellaneous vessels 65 per cent are French, 23 per cent British, 8 per cent American and 4 per cent Italian. Of the vessels engaged in convoying vessels across the Atlantic, 70 per cent are British, 27 per cent American and 3 per cent French.

The Sinking of a Submarine Chaser.—Although the sinking of one of our submarine chasers by the friendly steamship "Felix Taussig," with the loss of many officers and men, is a most heartrending tragedy, such an occurrence is to be reckoned as one of the perils of modern naval operations. Until the official findings are disclosed, which probably will not be until after the war, it is futile to make any criticism of this occurrence. The captain of the steamship "Felix Taussig" reported that at 2.30 A. M., August 27th, the lookout reported an object resembling a submarine about 200 feet away, off the port beam. Orders for general alarm were given by the captain. The craft sighted had no lights showing and was headed in the same direction as the "Taussig," the captain said. As it passed the steamship and crossed her bow, four shots were fired from the forward gun of the "Taussig." It was only after the third shot that the vessel showed lights, the report stated. Apparently two shots struck the submarine chaser, and it is believed that one shot exploded a depth charge.

Schwab to Standardize Ships.—General Director Schwab has taken steps to standardize the construction of ships throughout the country. At a recent conference in Washington attended by Chairman Hurley of the Shipping Board, P. A. S. Franklin, Chairman of the Ship Control Committee and J. H. Rossiter, Director of Operations, Mr. Schwab pointed out that there are 91 types of vessels now being built involving production of numerous parts which would not be necessary if ship construction were limited to a few standard types. The large number of types is due to the commandeering of some 2,000,000 tons of shipping on the ways when the United States entered the war. These vessels were completed according to design. A stage of construction, however, now has been reached where it is believed that the number of designs can be cut down to a minimum. Mr. Schwab announced his intention of building a fleet of 20 large cargo boats after the design of four ships formerly in Cuban trade. These ships will be used for carrying locomotives and motor trucks abroad. The hatches are so large that the locomotive can be loaded in the hull without removing any of the machinery and the engines are able to move away from the dock in France under their own steam.

Science

A Geography of the World's Agriculture.—Recently published by the U. S. Office of Farm Management, is an elaboration of an article which appeared in the 1916 Yearbook of the Department of Agriculture. It is a volume of 149 pages, with 206 text figures. Maps show the acreage and production of all the more important crops of the world, indicated by dots. This work will be an indispensable reference book for students of economic geography.

To Collect Old Scotch Maps.—The Royal Scottish Geographical Society has undertaken the formation of a national collection of old maps of Scotland and has issued an appeal for contributions of both maps and money. It is hoped to secure as nearly as possible a complete collection of atlases, charts, county maps, district maps, road books, town plans, manuscript maps, etc., issued prior to the time of the Ordnance Survey, about 1860. The earliest satisfactory maps of Scotland date from 1564.

Improvements in Aerial Surveying.—Major J. W. Bagley, who has been identified with the photographic work of the U. S. Geological Survey and is the author of a bulletin of that service on "The Use of the Panoramic Camera in Topographic Surveying," has recently been engaged, under the War Department, in training and putting into the field military aerial survey parties for the preparation of aeronautical maps. In this connection he has developed a new tri-lens camera and a special transformer.

The War and the Birth Rate.—According to Sir Bernard Mallet, the registrar-general of England, the loss of potential lives in England and Wales since the beginning of the war due to the diminished birth rate amounts to 650,000. The proportional loss in the other belligerent European countries has probably been even greater. Sir Bernard estimates that the war has cost all of these countries no less than 12½ million potential lives; in other words, the number of births has been smaller, by this number, than it would have been if the war had not occurred.

The "Northerns" of the Canal Zone.—While the tropical hurricanes that are so dangerous to shipping over the greater part of the Caribbean Sea do not extend their ravages to the immediate vicinity of the Isthmus of Panama, the latter region is occasionally visited by severe storms known as "northerns." According to a recent note in the *Monthly Weather Review*, these storms occur during the dry season, from November to April, when the Isthmus is under the influence of the trade winds, and are generally associated with the occurrence of exceptionally high barometric pressure over some part of the United States. The harbor of Colon, before the construction of the breakwaters, had a bad reputation among sailors for northerns. A partial list of those known to have occurred since 1857 is presented in the *Review* by R. Z. Kirkpatrick.

National Forest Range Plants.—Extensive studies have been made by the U. S. Forest Service for some years past of the distribution, natural habits and economic importance of its range flora, and about 35,000 plant specimens, representing 4,800 species, have been collected on national forests and purchase areas. Ecological and economic data have been furnished by the collectors of most of this material, and further data have been secured by the grazing experts of the Service. According to a recent address by W. A. Dayton, these data have application to many phases of range management; i. e., intensive range utilization, especially with a view to minimum interference with the requirements of the important forage plants, and the utilization of each type at the time and by the class of stock to which it is best adapted; detection, eradication, fencing, etc., of poisonous-plant areas; natural range reseeding; studies in plant indicators, plant succession, etc.

Breeding for Disease Resistance in Plants.—A recent paper by W. A. Orton in the *American Journal of Botany*, deals with this important subject. In any given locality nature gradually evolves varieties of plants that are more or less resistant to local diseases and insect pests. With the growth of international commerce, however, it happens more and more frequently that hosts and parasites belonging to different countries are brought together and the consequences are often disastrous. The problem then arises of finding in the region from which the parasite comes varieties of the plant which have acquired resistance to this particular disease and also of breeding for disease resistance from local material. "All plant breeding," says the author, "should take disease resistance into account. Strains under test should be exposed to infection by all the parasites that they are likely to meet in order to bring them into equilibrium, for it is possible by breeding plants in the presence of their diseases to produce resistant varieties." The breeding and introduction of resistant varieties and the elimination of non-resistant varieties solved the serious problem of asparagus rust (*Puccinia asparagi*) in this country.

Engineering

Chicago to St. Louis by Boat.—Work is proceeding on the canal between the Illinois River and Lake Michigan which will complete the waterway between St. Louis and Chicago. The locks are being repaired, the canal is being dredged, and aqueducts are being renewed. It is expected that the water will be turned into the canal this month. According to reports the Government is planning to construct power boats and barges for the Illinois River which can pass through this canal. These will carry cargo between St. Louis and Chicago direct.

Harnessing the Drave River.—A large hydroelectric plant was put into operation last May on the Drave River in Southern Styria, Austria. The present output is 30,000 horse-power, but the plant is to be enlarged. Current is generated at 10,000 volts and is supplied to local electro-chemical works. Part of the supply is stepped up to 80,000 volts and is used for long distance power transmission. Work on this project was started in 1913 and it has been much delayed by the war. The river is closed by a dam which raises the water from 35 to 50 feet. Navigation is carried around the dam in a canal furnished with two locks.

Railroad Embankment of Molten Slag.—The plants of the Carnegie Steel Company in the Monongahela Valley are disposing of their slag to build a railroad embankment along the river. The molten slag is hauled by ladle cars which are provided with compressed air dumping mechanism which may be operated from the locomotive. The mechanism is locked to hold the ladles from spilling slag along the track. Bridges are floored so that there will be no damage from slag that may drip over. The wall of the embankment is faced with blocks of cold slag, and the space behind this wall is filled with the molten material. It makes an excellent material for railroad embankments and for filling in low ground areas.

Night Surveying in the Desert.—In laying out the 17-mile tangent of the Lincoln Highway across the Utah desert it was found very difficult to carry on the work in the day time. Says the *Engineering News-Record*, the sunlight reflected from the fields of glistening salt and alkali, is so dazzling that it blinds the eyes, unless they are protected by dark-colored glasses, and the rising heat waves distort the shapes of objects sighted and produce fantastic effects. These factors and the familiar mirage would result in inaccuracy and confusion unless proper methods were employed for establishing the lines. Under George F. McGonigle, state engineer and a member of the State Road Commission, this tangent was established by signal fires at night. The connecting levels and transit lines have been run during the twilight hours. Construction of the new direct route, which will eliminate 50 miles of extra travel around the south point of the salt marsh, is under way. A force of convicts is also improving the Fisher Pass section.

Women Navvies in a British Shipyard.—Commenting upon the remarkable work of converting the waste land of Hog Island into a huge shipbuilding plant in a few months' time, our London contemporary, *Engineering*, calls attention to a similar piece of work done on a smaller scale "somewhere on the North East Coast," of England. Here a piece of ground that lay below high-water level has been converted into a shipyard of eight berths. The work was started in March and the first ship, it is expected, will be launched in November. Female labor is being used very extensively in the construction of the yard. Women feed the concrete mixer; they lay and ballast the rails, they fill the low ground; they excavate the site of the wet dock, which will accommodate several vessels simultaneously, and in fact undertake all kinds of work which have hitherto been deemed quite unsuitable for their sex. A canteen capable of feeding 2,000 workers has been erected. A number of model cottages are being built, and also a hostel to accommodate 1,000 men.

The Protection of Mines Against Explosion.—In connection with the extension to various commercial mines of the experiments made by the Bureau of Mines on the use of rock dust for the prevention of dust explosions in coal mines, it is desirable to have a rapid method for determining the percentage of incombustible matter in the dust collected from roadways in the mines. For this purpose the Bureau modified the Taffanel volumeter and combined it with a compact portable outfit which could be easily transported to the mines. With this apparatus determinations can be made at the surface, or at convenient stations in the mine, to ascertain whether the desired proportion of rock dust has been added to the coal dust. A detailed description of the outfit, the method of calibration and operation, and the results obtained in its use are given in Technical Paper No. 144 of the Bureau of Mines, in order that mine operators may avail themselves of this simple method of determining the proportion of protective non-combustible material in the road and rib dusts of their mines. The paper in question will be sent free on application to the Bureau.

Good Housekeeping in the Factory

Effect of Esthetic Surroundings Upon the Man at the Machine

By A. Russell Bond



A factory for making drills and internal gear axles, laid out like a park

A GREENHOUSE may seem out of place in a factory devoted to the making of drills and internal gear axles for motor vehicles; and yet that is what I found in a little town in Michigan. It is a small town, hardly large enough to appear on anything but a railroad map, and the manufacturing plant is really the life and soul of the village. Strange as it may seem, the greenhouse might almost be considered the life and soul of the plant, for on it, in large measure, depends the industrial success of the institution.

The relation between employer and employee has undergone a radical change in recent years. No longer is the status one of master and servant or hireling, but the manufacturing plant is looked upon as a big community of which the man at the machine is a member. Even the term "operative" does not fully describe his position in the ideal organization; instead he is rated as a "cooperative" for he shares in the interest and also in the profits of the company.

There are various ways in which the co-operative scheme has been worked out. Every large plant has its welfare department, in which the interests of the individual are looked after. Not only is attention paid to his personal safety, but studies are made of his home conditions, and everything is done to raise the tone of the employee. This has been found essential to successful operation of the plant, because a contented man will do better work, and if a man is happy in his home this will be reflected in his work at the machine. However, in all welfare work there is danger of paternalism—men of a certain type are perfectly willing to sit back and let others do for them; the more they receive the less will they do for themselves. On the other hand, there is a class of self-reliant men who resent the efforts of the welfare worker and look upon him as an intruder. Welfare work calls for a great deal of tact, which, unfortunately, is not always exercised.

It is right here that the idea of the greenhouse comes in. The president of the plant referred to has his own notions about welfare work. He sums it all up in the

idea of "good housekeeping" in the factory. He believes in appealing to the man who wishes to be treated as a man and does not wish to have his home affairs meddled with. He can quite sympathize with the family which resents having a welfare nurse come around to show mother how to wash the baby. He believes in treating his employees not as children but as *men*—men who have sufficient independence and self-esteem to take care of their own welfare. He realizes the importance of exerting an influence on his employees which will reach to the home, but he has tried to do this in an indirect and inoffensive way. For this reason he has converted his plant into a park. The grounds have been laid out by a landscape gardener, with well-trimmed lawns, flower gardens, shrubbery and shade trees, while the ivy-covered buildings are pleasingly and efficiently grouped and the interiors are kept clean and tidy, with plenty of light. Working in surroundings such as these, the employee feels the dignity of his job. He finds in his surroundings an inspiration to cleanliness—which makes for better work. This builds up his self-esteem and is bound to be reflected in his earning capacity.

A manufacturing plant is a man's home for at least half of his waking hours. If he spends half of his conscious time in good surroundings he is bound to seek to improve the surroundings of his home as well. In that way, the greenhouse spreads its influence throughout the whole community, and this reacts again upon the industrial efficiency of the plant.

This is but part of the welfare scheme of this plant, and while unimportant in itself, is of interest as indicating the indirect value of apparently outside influence on the general morale of a manufacturing plant.

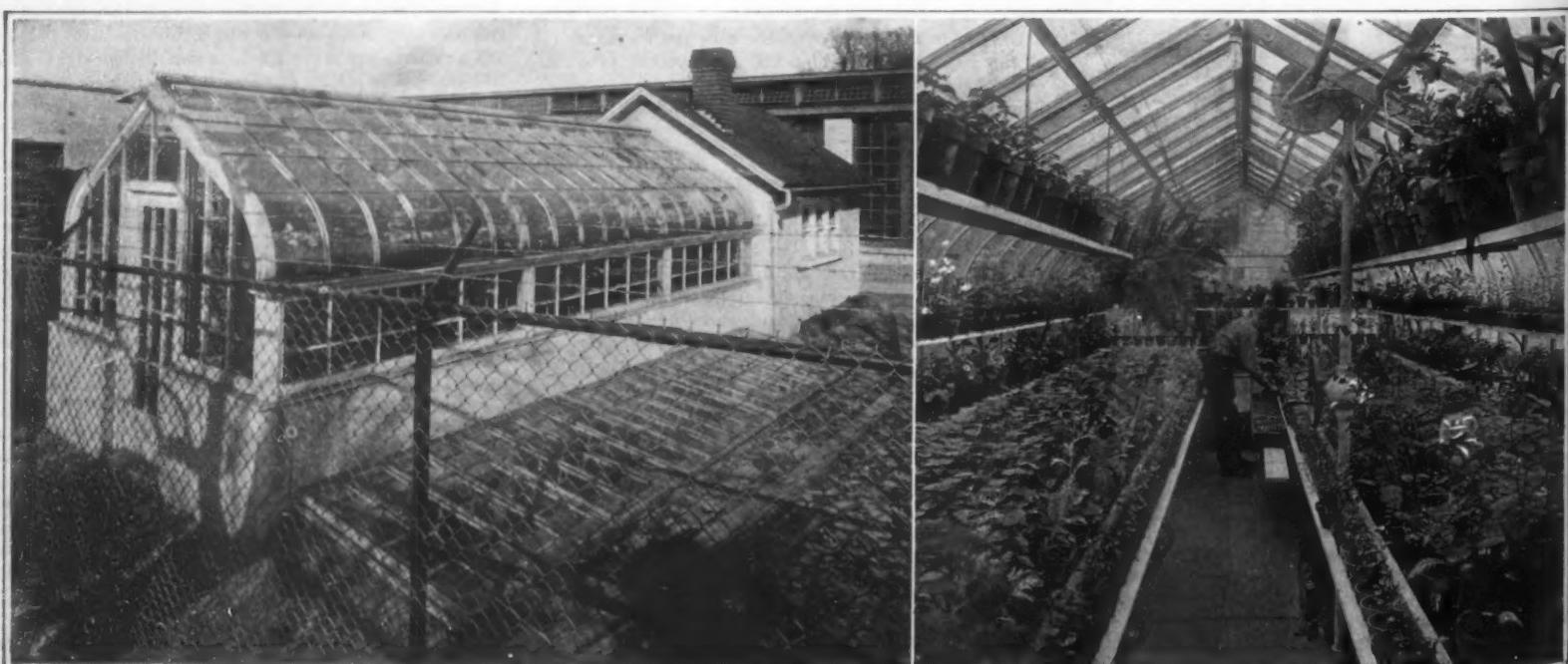
In every organization there are to be found plenty of men who are full of ambition to succeed and better their conditions of life. In plenty of others the ambition is dormant, but it can be awakened if proper methods are used. Sad to say, in every such community there is a large percentage of men, usually amounting to

about 30 or 40 per cent, who seemingly cannot be stirred at all. It is hardly worth while to do much for such men, but it is to the 60 or 70 per cent of employees who are capable of improvement and that are anxious to better their lot, that welfare work should be directed. In this plant everybody has a chance to succeed, and there is no limit to the height to which he can ascend.

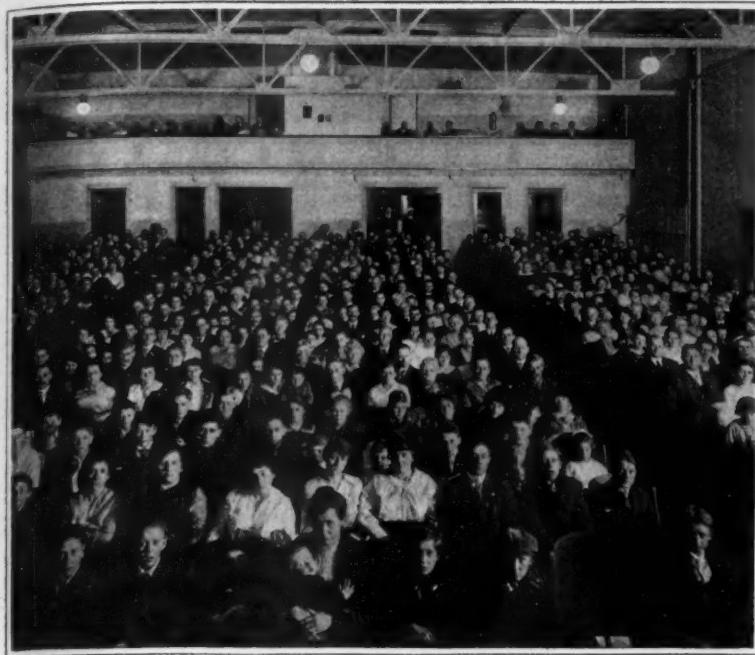
Aside from the influence of pleasing environment the employees are given the advantages of a profit-sharing scheme, which is most liberal. Any employee is entitled to subscribe to what is known as a Subscription Lot consisting of one share of Preferred and one share of Common stock, together with one share of what is called an Employee's Participating Certificate. This certificate bears no par value but receives a liberal interest from the annual earnings of the company. The subscriptions are paid for at any time and in installments of any amount not less than \$1.00 each. All cash dividends become due and payable after subscription, whether or not a final payment has been made; and such dividends are credited upon the subscription until the subscription is fully paid up. In this way the employee is induced to take an active part in the affairs of the company. He feels that his earnings have a distinct bearing upon the success of his company, and result in increased payments of dividends.

Houses of attractive design have been built by the company and are sold to high class employees at extremely liberal terms.

There is an employees' benefit association and not least among the attractions is the company band. As a part of the welfare work the company has built a very pleasing little theater, fully equipped with foot-lights, spot-lights, screens, and apparatus for producing various scenic effects and illusions. A stock company has been formed among the men and very creditable performances have been staged. Last winter, a performance played to a full house every night for two weeks, at fifty cents per seat, and the proceeds were



The main office of the chief gardener who is responsible to a large degree for the "tone" of the factory



A full house in the company's theater



View in the foundry, showing the electric furnaces pouring

voluntarily turned over by the men to the Red Cross organization.

One or more of these various schemes of co-operation will catch the interest of practically every employee. The community spirit pervades the whole organization, and I could clearly see it reflected in the faces of the men and in their energetic work. It may be questioned that a plan such as this could be carried out in a very large organization, but it has proved ideal at this plant, which numbers 1,200 employees, and no doubt it could be developed in even larger plants were they subdivided into smaller communities. And, by the way, the necessity of subdivision has come to be recognized by certain organizations which have grown so large as to become almost unwieldy. That plant is bound to succeed which converts its "operatives" into "co-operatives."

Difficult Subway Work Under Land and Water

DURING these stirring times public interest in engineering work that has nothing to do with the war has very naturally lagged to a considerable extent. This is particularly true of the building of new subways in New York, for the construction is carried on under ground and progress in the work is not very apparent.

The recent opening of the so-called "H" system involving a shuttle line across 42nd Street, connecting the east and west side subways, naturally aroused the interest of New York citizens, although the annoyance they experienced in getting acquainted with the new lines of travel was such as to make them overlook the splendid engineering work that had been accomplished. Much of this confusion would have been avoided had the subways been built out in the open where they could be seen, but the bewildered passengers got lost in underground galleries with which they were entirely unfamiliar, not even having a map to guide them. Had illustrations been prepared showing the new subway lines with the earth covering removed from them, and had these pictures been widely advertised, no doubt there would have been a more auspicious inauguration of the "H" system.

A drawing of the kind we refer to appears on our title page this week. This shows a spot off the end of Manhattan Island where there is a tangle of subway tubes made necessary by provision for future changes. It is contemplated that here some day, there may be a change of subway lanes of travel in a measure comparable to that furnished by the "H" system.

It will be recalled that the express trains which travel down Broadway from 42nd Street, run across town at Canal Street and thence go over the Manhattan Bridge to Brooklyn. The local trains, however, run on down Broadway, turning into Church Street to avoid the old subway. Eventually the line will be extended down through Whitehall Street under the East River and on under Montague Street, Brooklyn. This connection with the new tubes that are being built under the river is in a measure temporary. Some day when the plans are fully worked out

there will be a subway line running down Nassau and Broad Streets from the Municipal Building which will connect with these tubes, while another pair of tubes will connect the Whitehall Street line with Atlantic Avenue, Brooklyn.

It is to provide for these future changes that the complex system of tubes has been built off the end of Manhattan Island. Fortunately, the work here is in rock, otherwise it would be most difficult to make the necessary junctions of the tubes. At present the Broad Street tubes are dead-ended a short distance within the bulkhead line, while the Atlantic Avenue tubes have been extended far enough to permit of working upon them without interfering with train service

It is contemplated that when the Broad Street line is in service and the Atlantic Avenue tubes are completed, the two tubes running to Whitehall Street will be employed for car storage.

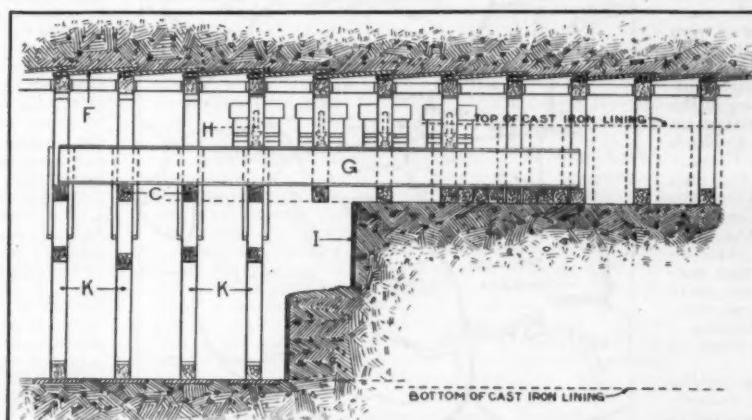
An examination of the drawings will give one some conception of the elaboration with which new underground rapid transit service is being worked out and also give an impression of the engineering difficulties that have to be contended with.

Farther up the East River, paralleling the tubes that run to Montague Street, is another pair of tubes running to Clark Street, Brooklyn. If we follow this tunnel across the river we shall come to a very interesting piece of engineering work at the Henry Street station. The cast-iron lining of the river tubes is continued along under Clark Street in tunnel through the sandy soil, as it lies too far under the street surface to permit of the usual cut and cover system of construction. At Henry Street the problem was to transfer the enormous load on the tunnel tubes to columns between the tubes so as to permit of cutting out the lining at the station and provide access to the station platform.

The method of doing this is illustrated in the accompanying wash drawing, which shows four of the six steps into which this work naturally divides itself. The first proceeding was to place longitudinal timbers A in the tubes and wedge vertical posts B between them. This done, an upper heading was driven between the tubes and the load was carried by means of short cross timbers C wedged between the tubes on which were placed the vertical timbers D supporting the roof timbers D. Posts were also set up on the tubes to carry the outer ends of the timbers D. The heading was pushed forward by the use of poling boards F, as shown better in the line drawing. This drawing represents a longitudinal section of the work and also shows the second step, which consisted of introducing a pair of needle beams G to pick the load off the posts. The needle beams rest on the timbers C and special needle sills at the rear, and roof beams D are carried by means of pump screws H while the bents are being excavated. Breast boards I and J prevent the sand from caving. In this way the excavation is carried down to subgrade.

In the third stage of the operation we find the posts K erected and cross bracing L in place, transferring the load from the outer side of one tunnel tube to the outer side of the other. In the fourth stage, which is not illustrated, the tunnel lining is taken away, the longitudinal girders of the station platform are put in position and the concrete base between the tubes is built up. The longitudinal girders are shown at M in the fifth step and in this stage are also introduced the upper transverse girders and longitudinals N. These are supported on columns O resting on the girders M and finally in the sixth stage, the station platform is completed, as shown at the left hand end of the drawing.

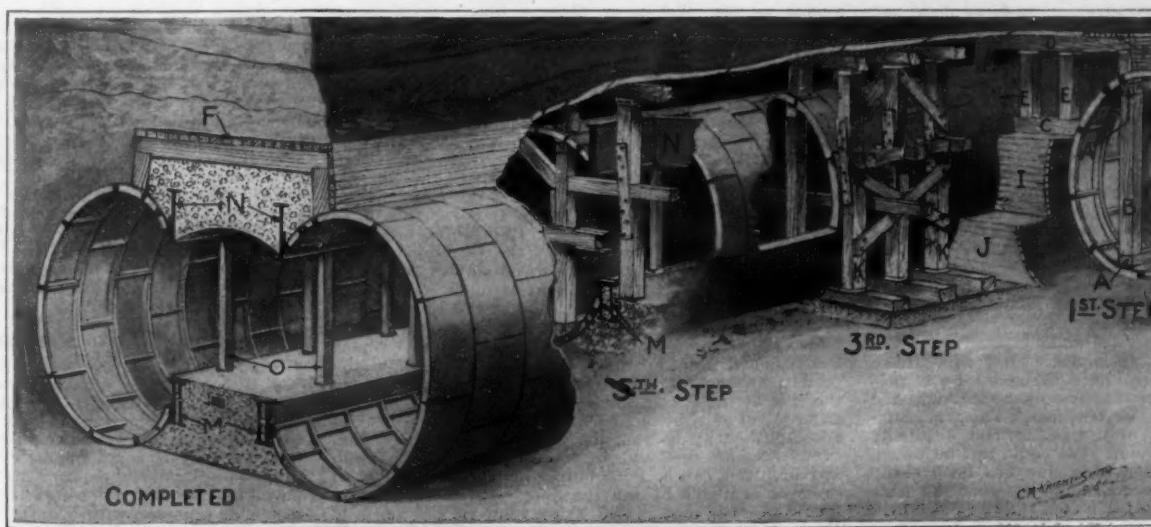
As may be imagined, this work was most difficult owing to the sandy soil and the depth of the subway at this point, which was ninety feet below street level.



Longitudinal section showing the first and second steps in the construction of the Henry Street subway station

through the Whitehall Street tubes. The work is complicated by the fact that grade crossings between the Broad Street and Whitehall Street tubes must be avoided and also by the fact that the Atlantic Avenue tubes must pass under the existing subway tubes at South Ferry.

It will be noticed that the Manhattan bound tube running to Whitehall Street passes over the Brooklyn bound Broad Street tube, so that a grade crossing here is avoided. There is a large construction shaft beyond the bulkhead line which is connected by galleries with the Broad Street and Whitehall Street tubes. This will be used for ventilating purposes and also as an emergency exit in case of accident.



How the subway tunnels were cut into and the space between them excavated for the Henry Street Station, Brooklyn.

Strategic Moves of the War, September 4, 1918

By Our Military Expert

EVENTS have been moving swiftly since the beginning seven weeks ago of the French Generalissimo's strategical blows on the western front, first in driving the enemy from the Marne to the lines of the Vesle and the Aisne and then in following up this success by hammer blows to the north, struck in rapid succession from the Lys salient and Arras to Soissons; many have been in a way small blows that cannot be called battles in this gigantic struggle, but still sufficient to produce as a whole a general dislocation of the German lines. Relatively, in each blow so far struck, comparatively few men have been used—but, after each, the victorious troops have been in a short time ready for another effort. Since the middle of July the Germans have had no rest nor time to reorganize their shattered forces; each Allied attack has but added to their confusion and to serious injuries at the different parts of their holding lines. It is difficult to call attention to any particular part of the front especially between Arras and the junction of the Aisne and the Vesle—an extent of more than fifty miles. The British blow between Arras and the Ancre was selected first, undoubtedly because it was a country well suited to the use of small tanks, now such an important adjunct to all infantry operations. At first the advance of the British forces was not so great as in the other parts of the lines; but the effects were rapidly felt far south of the Ancre and Somme Rivers and ultimately they have probably proven to be the heaviest strokes needed to break down German opposition east of the original lines of Arras, Bapaume, Péronne, Nesle, Roye and Noyon. At present the greatest successes have been the capture of the towns of Bapaume, Combles, Péronne, Nesle, and Noyon; the advance is still continuing toward Douai, Cambrai and St. Quentin. On the front to the east and northeast of Compiègne the most far-reaching results have been gained in clearing the enemy from most of the country east and north of the triangle between the Aisne and Oise Rivers; any advance here would of necessity have immediate consequences for all the German forces west of the Oise and south of the Aisne, since a rapid advance up the Oise valley would force the withdrawal of the German flanks between Soissons and Rheims on the east and between Chauny and Ham on the west and north—in other words, if a retirement had not taken place, a wedge would have been driven between the two wings of the German army east and west of the Oise River. The French guns now command the main high road on the west bank of the Oise all the way from Noyon to Chauny; the French hold the left bank of the Ailette River from its junction with the Oise below Chauny nearly to Coucy-le-Château while their right wing is working north and east to clear the country in the vicinity of Soissons and to cross the river further up toward Aisy. These moves will enable them to reach and cross the main highroad from Soissons to Chauny and also to threaten the Germans occupying the high grounds beyond Chavigny and Juvigny north of Soissons both of which have just been captured. The most recent reports show towns captured beyond the highroad so that the French forces have now cut that important line of communications. The surprising successes of both the French and British troops have rendered untenable practically all of the ground originally gained in the Amiens salient, and are forcing a withdrawal to the old Hindenburg lines in front of Cambrai, St. Quentin, La Fère and Craonne.

At the present moment, the ultimate aim of the strategic plan of the French commander is not entirely plain; some believe his idea is to weaken by successive blows the numbers of the enemy preparatory to a decisive stroke at a vital point. But it is more than probable he intends to disorganize what is a great German retreat on large parts of their lines and to make captures of large amounts of material and of prisoners, leaving till later what the results of his efforts may show to be best. It may however, be possible that the first steps are being taken for what may turn out to be the greatest battle in the history of the world and that these first steps are about completed; it is evident at any rate that the Allied maneuvers have been carried out so far with the view of placing the Germans in the position in which they now find themselves—where they cannot make a retreat without grave risk of its degenerating into a rout and where they cannot make a stand without most serious losses. The fighting now is being carried out on the two wings; in the north the Germans are making the strongest resistance, though not with success. In the south, in the region of the Oise there is apparently a general demoralization, such as does not exist around Arras and east of Croiselles; but this apparent demoralization may be due to the fact that, behind the wing, there are a number of positions easily defended to which the Germans are now rapidly withdrawing. These positions are the plateau of St. Gobain, La Fère, Laon and the Chemin des Dames hills, all of which have shown their value many times earlier in the war. Just at this stage, however, the French appear more anxious to move along the valley of the Oise in the direction of Chauny, to which place and to Ham further north the Germans are retreating. The latter, realizing that one pivot of the Hindenburg line on the south is that portion from La Fère, south to Coucy-le-Château and the Chemin des Dames, will no doubt strengthen the defense here unless, as now seems probable, the line can be broken on the Oise at La Fère by the French Tenth Army now coming up the river.

On the north, the British are making progress on the main road from Arras to Cambrai. They have taken Bullecourt where so many hard struggles have previously taken place and have broken through the famous Quéant-Drocourt switch line. This, in combination with the old Wotan line, formed originally two strong defensive positions that could not be taken. In the present move the Wotan line has been easily passed and the Quéant-Drocourt line has gone the same way. The British have just defeated the German forces in one of the greatest and probably most important battles of the war by breaking through the center of the

Quéant-Drocourt line on a six-mile front east and south-east of Arras; despite the most desperate resistance the Germans were driven back with great losses both in men and guns. This northern hinge of the Hindenburg lines had already been passed by the capture beforehand of Bullecourt and other villages; the present break has swept over the lines from the Scarpe River almost to the Bapaume front. The fighting is still going on without any let-up and with no opportunity for the Germans to stabilize their resistance at any particular point. The loss of the switch line has thrown the Germans behind the northern hinge of the Hindenburg line and will open up the way to Douai—one of the main strongholds of the German lines in Artois and Flanders. The capture of Bullecourt and the villages near it gave a strong foothold in the Hindenburg lines and proved an entering wedge for breaking or outflanking parts south of Quéant not before reached by the British. If the present advances can be continued, Bullecourt and its corner will have proven a turning point in the campaign, though the Germans may have another line by this time running from Lens through Douai to Cambrai and beyond. If no such line exists, the present break in the Hindenburg lines will throw the Germans back upon Tournai-Valecenes-Avesnes-Hirson or the Meuse River. Such a retreat would be surprising—but no greater surprise than the successes being witnessed at present have been. Perhaps just now is occurring one of the crises of the war and only a few days will be needed to determine if such is the case. The latest hopes of the Germans have been to hold fast at the Hindenburg lines; but the astonishing British victory now being gained shows that but little reliance can be placed on such defenses. The Allies have driven through the northern hinge and are east of the lines the Germans have so far fortified; so that the present break in the German defense is the most serious yet made in France by the Allied thrust. This break has apparently been particularly directed at the capture of the three cities Douai, Cambrai and Valenciennes, which, on account of

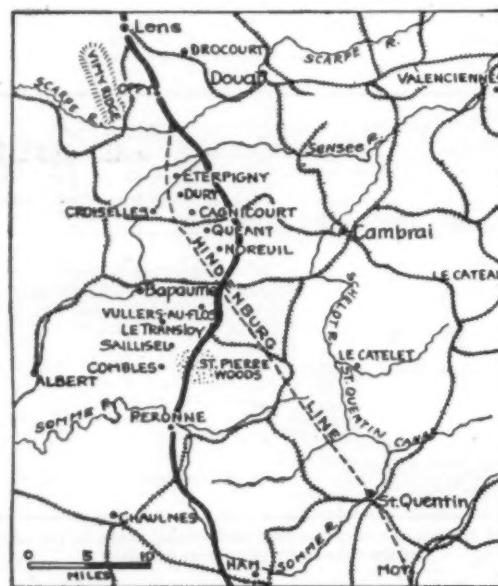
important moves are being carried out at various points. The strategy of Marshal Foch is keeping the Germans guessing and constantly on the "qui vive." Formerly the French and British, after due artillery preparations, made straight head-on drives that night or night not be successful but were always costly in loss of their men. They might or might not attain their objectives; but, no matter what happened, there was always a pause after the drive. The Germans in every one of their five drives of the present year, have followed the same methods with the same results. But the French generalissimo is acting differently. He is gradually filtering or diffusing his forces into the German lines at many different places between Soissons and the Lys salient. By keeping his reserves in hand, the German front for eighty or one hundred miles is constantly under pressure and, where a gain is made at one place, another place is made untenable for the enemy. By this process of filtering and also by envelopment or outflanking, he is gaining more at small cost than was formerly obtained by direct attacks that were followed by heavy losses. So far there have been a number of direct and supplementary drives that have so linked up and intertwined, one with another, that the retreat of the Germans cannot cease anywhere until it comes to some line where a permanent stop can be made. There is no short pursuit followed by a deadlock; the retreat has kept up for days and will continue while the various moves of the French offensive can be maintained. The value of the strategy followed and its possible results have been shown in the disorganization of the German forces and in their failure so far to find a line behind which they can stand. The retreat is apparently still enroute to the Hindenburg line, but there is no certainty that it can be stopped when that line is reached; the German destination is now unknown. Unless the German commander can check in a short time the forward movement of the British or the northern hinge of his lines, there is a possibility that his defeat will increase in magnitude and will develop into a disaster or into the decisive battle of the war; because, if he cannot stay the Allied advance at the Hindenburg lines, then the German armies must begin a long retreat to the Belgian frontier coupled with all the consequences that will follow in the loss of men and material and, what is more important, in the loss of morale among the fighting men. The fighting now in progress is most serious for the Germans; it has lasted continuously for six weeks and gives promise of a still greater duration with more victorious results for the Allies. It has netted them 130,000 prisoners and more than two thousand guns, while it has reduced the strength of the Germans on the western front from 225 divisions to about one hundred and ninety. The greater part of the ground gained in the spring and summer advance has been recovered from the Germans, and as yet the latter have found no way of breaking off—for them this most costly battle.

The retreat has already shown the German army, the German people, and the world at large that the German military power can be broken and that the war, so far as Germany is concerned, will henceforth be a defensive one. It has also shown that, in view of the continued arrival of American reinforcements, there can be no ultimate possibility of a success for Germany. The only result can be the putting off of the day of reckoning when an enforced peace will have to be made.

Little or nothing has been heard recently of any active operations of serious moment on either the Italian or Saloniki fronts. But a new eastern front is being gradually developed in two senses—one military and the other political. It is true that large Russian armies cannot be expected to be created under any of the present conditions prevailing in the country. But the accidental intervention of the Czechoslovaks, held prisoners in the country, but released when Russia collapsed, has led to a new situation that has finally ended in their recognition as belligerents by our own government as well as by the British and French. Practically this recognition means a dismemberment of the Austria Empire on the conclusion of peace. The principal centers of strength of the Czechoslovaks, estimated at one hundred and twenty thousand men, is in Siberia where they control Vladivostok, the greater part of the Trans-Siberian railway to and beyond the Ural mountains into Russia and also a front on the Volga River extending from Kazan to Samara, a distance of 200 miles. Aided by British, French, Japanese, and American troops and supported by the law and order elements of the Russian population, they are gradually acquiring control throughout Siberia and eastern Russia and, if the war lasts long enough, may be able to establish a true military front against German forces. The Allied troops that have entered northern Russia through the Kola peninsula and Archangel are gradually moving south and overcoming Bolshevik resistance at several points. Through the support a new state has been established, consisting of several of the provinces or divisions in northern Russia. As the population of this part of the country is friendly toward them, they will probably be able in a short time to reach Vologda, the important railway junction between Petrograd and Moscow. Russia may yet prove to be a graveyard of blasted hopes for, if once the latter's military grip relaxes, there will be millions of Slavs ready to rise and strike for freedom against German tyranny and arrogance.

Easy Way to Remove Old Putty

OLD putty can easily be removed from window sashes by the following method which prevents any cutting or defacing of the sash. The sash is taken out and laid flat on a table with the putty side up. Common spring-bottom oiler, filled with gasoline, is used to squirt a small quantity of the spirit along the putty all around the panes. A match is then set to the petrol and the heat will soften the old hard putty so that it can be removed with a putty knife. If the putty is very hard, a second application of the petrol may be necessary.



The British drive toward Cambrai

their road and railroad facilities, have been the centers of supplies for the German armies in this part of France; their capture by the British would disorganize supply service both to the north and south. If taken by a rapid advance, the Germans would lose vast supplies of stores that can not now be well spared by them after their recent heavy losses. By breaking through the Quéant line, the British commander has opened his way for an advance in open country on any or all of these cities; the only obstacles to be found would be canals and rivers, none of which would prove nearly as difficult to surmount as the Wotan or Quéant lines. With these cities in their possession the British would be in a position to strike at the German flank in Belgium or against the flank and rear in France; in either case, the German army would be in grave peril.

On the northern end of the line the British have retaken Mont Kemmel; this dominates the whole eastern end of the Lys salient that was taken by the Germans last April at such a fearful sacrifice of human life. The British have also taken Bailleul and villages at the foot of Mont Kemmel. In fact the Germans are withdrawing from this whole region as the British have advanced one or two miles on a 12-mile front against strong resistance on the part of the Germans. As a whole the Allied advance has however slowed down in a measure compared with the progress made a few days ago; in fact there is a suggestion that the French commander is probably preparing to strike a very heavy blow somewhere. While the resistance of the Germans has stiffened notably, this would not fully explain the present apparent lull in the attacks. All the men on the side of the Allies that go into action are fresh and eager to get on the firing lines. This expedient is usually accomplished by moving the troops after every action, even a minor one, and by replacing them with fresh arrivals; this can be done on account of the number of reserves available behind the lines. By these arrangements there is always stiff fighting on various parts of the lines, giving the Germans no opportunity to recuperate and rest. Even during a comparative lull, im-

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Advertising With the Cinematograph in South America

To the Editor of the SCIENTIFIC AMERICAN:

Your issue of August 3rd contained an illustrated article of "The Cine-Motor-Movies" Equipment of the British Government, by Fred. A. Talbot, which was of great interest to an old reader of your valuable journal.

I hope my suggestion herein given, may be the means of making a very profitable use of such an idea by our manufacturers of any and all such merchandise that even now, and more so after the close of this beastly war of the nations, may assist in introducing and showing to foreign merchants, and our Central and South American neighbors in particular.

The writer of these lines has lived many years in one of these Southern countries and knows that just such means of display would be more than welcome, and bear fruit a thousand fold.

My idea is this, perhaps not entirely new, but the fact remains just the same.

An outfit, such as described in the article referred to; to travel through the country, giving free out-door exhibitions of our principal manufactured products in all their various manufacturing processes, such as would make up our most and best articles of commerce for the foreign trade. Thereby showing to our Southern neighbors all of the detailed operations as far as practical in the manufacture of our merchandise. At the same time the operator might be supplied with a number of comic, art and travel films to intersperse between the different mechanical films; so as to interest the spectators and hold them in a pleasant evening free show.

I have seen some similar exhibitions a number of years ago in several cities in a southern republic, and the crowds of spectators were many thousands.

I believe these exhibitions were mostly rotten up by French interests and were stationary in their respective locations. The apparatus was set upon some high building near a public square and the screen was set upon some building opposite, thus making it convenient for all to see. However, the first named movable outfit would facilitate the operator to travel into the smaller towns in outlying districts and provinces, where the rural population would also receive the educational benefit of the free exhibitions.

A. O. BARKOFY.

Covina, California.

Coming Back To a Peace Basis

To the Editor of the SCIENTIFIC AMERICAN:

"Coming back to a Peace Basis" by Mr. Harrington Emerson in your issue of August 3rd, in my opinion deserves more than passing notice. Not only is this subject handled by the author, who doubtless gave to it much thought, but is to be considered timely in as much as he (the author) states that millions of men will shortly return from the war to find their former civilian positions filled by other applicants.

Mr. Emerson points out how the sudden coming to peace and conditions arising directly thereafter, will be harder to adjust than the initial progress of waging war. The aftermath of many other wars would seem to bear this out if we take history for precedent.

Mr. Emerson further shows how the Government by erecting many and large elevators and perhaps other kinds of storing edifices and accumulating therein vast quantities of such products as wheat, grain, etc., and acting as a price stabilizer and automatically allowing these prices to decrease while coincidentally fixing the value of silver, since the United States controls 47 per cent. or practically half of this commodity with Canada and Mexico supplying nearly as much more. We would "kill two fat birds at one time" and automatically compel the cheap labor and cheap product of even the Orientals to compete with us on practically our own basis.

This seems to me to be a very good plan with the possible exception of the time it might take to accomplish this. Would it not take months, perhaps years for our Government to work out its economic relations with other Governments on a 50-50 basis this way?

Since time will very likely prove to be such a tremendous factor in restoring trade balances and industrial equanimity after the war, it follows that the soldiers who have offered and many of them given their all that we and the world may enjoy the blessings of freedom, are very likely to be the ones most immediately disturbed by these conditions; since they, least of all, can abide their time, their means of making a livelihood for the time largely replaced by other labor.

Therefore, I would respectfully suggest that for a period of three or four years following the day that peace is made, and not to be put off a day longer than succeeding this happy event if possible, that not only our Government, but the several Allied Governments usher in an intensive building and improvement program on a vast scale.

As a matter of course, and to be looked for in France and Belgium and other nations who have felt the heavy tread and devastating hand of the ruthless invader, building operations on a commensurate scale would first of all engage their attention.

For America and England and other nations the invader would have liked to invade, but was prevented by sheer force of arms and man-power—vast improvement operations to include good highways of all kinds; larger and better schools and more of them, to say nothing of innumerable other subjects of a public nature which could come under this head for the betterment of a wide scope of territory.

Thus could employment be given at once to all who were able and desired it.

Since those who are physically handicapped by the war are taken in hand by their respective governments and taught some useful trade, would it not be fair to assume that the same Governments, acting under the same generous impulses, be prompted to do something for their more able-bodied sons who are temporarily handicapped for making a living by a handicapped economical condition simulating fate, which has found itself in an uneven place with the sudden ending of war and only needs a few years, perhaps three or four to again re-assert and re-adjust itself in an automatic way to peace times?

E. M. BLACKSHER.

Brewton, Alabama.

Streamline Efficiency

To the Editor of the SCIENTIFIC AMERICAN:

Since the advent of streamline forms in airplane construction the writer has always been an enthusiastic convert of this method of reducing head resistance and promoting greater efficiency of the airplane. While it is true that a majority of the constructors are giving the streamline form of construction considerable attention, I am of the opinion that greater efficiency could be obtained if they would give this important matter the amount of scientific research and experiment that previous results seem to warrant.

For the most part it is the custom of present-day designers to construct streamline forms on practically the same scale for all purposes, seemingly neglecting the function that it is to perform or the speed at which it is to travel. If the present theory of the streamline form is correct, then it is obvious that a perfectly designed form, designed for a speed of 30 miles per hour, would be a poor and inefficient design for twice that speed.

If my knowledge of this subject is correct, what we call a streamline form of good design is a rather oblong or oval shape body having its maximum thickness one-third back of the forward edge and tapering to a point to the rear. The theory is to pierce or separate the air with the least possible disturbance to the maximum amount of the body's displacement with the first third of its length, allowing the air to "close in" on the gradually tapering remaining two-thirds and thus exerting a forward force much in the same manner as if we grasp a slick, slimy fish just back of the largest point of the body and try to hold it tightly with the hand.

Assuming the above theory to be correct, is it not a fact that in order to obtain the highest possible results from this form of construction it will be necessary to design each body for the speed at which it is to travel? If the above form of construction functions perfectly at say 30 miles per hour, would not the point of maximum thickness have to be moved one way or the other when traveling at twice that speed, in order to allow for the variation in the air's reaction? It seems reasonable that if the air is separated at a greater velocity it will be slower in reacting and the body will have moved forward to such an extent that most of the "closing in" or reacting force will fall short of its mark.

Examination of quite a number of airplane bodies shows only a feeble effort on the part of most designers to carry out the streamline principle, sacrificing many of the advantages of this important factor for slight matters of convenience in construction or engine arrangement.

The importance of perfectly designed streamline forms is clearly illustrated by experiments showing that by substituting streamlined bracing wires for the ordinary round ones in certain types of machines, will effect a saving of 10 horse-power at 70 miles per hour. Other points of parasite resistance show equally gratifying results when subjected to a thorough streamlining effect. Undoubtedly designers, engineers and constructors in general are neglecting one of the most important factors in airplane efficiency through lack of sufficient scientific research and experiment.

GEO. W. WILLIAMS.

Temple, Texas.

Airplane Facts and Fallacies

To the Editor of the SCIENTIFIC AMERICAN:

In justice to myself and other readers of your interesting publication, I wish to take a few exceptions to an article appearing in your issue of August 24th under the head of "Airplane Facts and Fallacies" to which appears the signature of Ensign Hazen Pratt.

To begin with, I am of the opinion that Ensign Pratt is a typical example of that class who read into an article far more than the author intended to convey. It was not my intention to state in my article on the nose spin that I considered this spectacular antic of the airman as always ending fatally. Indeed, I have viewed this "stunt" with ever increasing interest—yes, even envy, and I am aware that it is a part of our airman's regular training. Neither did I intend to convey the idea that I had found a practical solution of the problem. I only intended to discuss those cases which did prove fatal and I presented my theory with the hope that a discussion of the matter might suggest an idea to someone who would be able to offer a plausible solution.

My article was not written "through lack of technical knowledge" or through mere "hear-say" as suggested by Ensign Pratt, but was prepared with much thought after reading an interesting account from one of our airmen at the front in which he stated, among other things, that machines sometimes go into a spin suddenly when the controls are locked and the pilot is busily engaged in a machine gun duel with the enemy. "In such a case," he writes, "should the spin obtain sufficient momentum, there is little that the airman can do to save himself, as the controls are useless and only tend to accelerate the spin." My suggestion of reversing the motor to set up a reaction to the spin would be but a natural deduction with nine persons out of ten, whether it was practical or not. Also, if the machine went into a spin with the controls locked as suggested above, it would be reasonable to suppose that these controls were locked at normal; this being the case, there can be but one apparent cause for the spin and that would be the engine torque which we know to be a considerable stress in the direction opposite to the rotation of the

propeller, hence my statement that the spin (speaking of those which always prove fatal), always occur contrary to the rotation of the propeller.

"How would Mr. Williams reverse the motor?" pointedly asks the Ensign. There was nothing in my article to indicate that I knew exactly how this could be done, though I am satisfied that it could be successfully accomplished should it be found that this was a practical solution of the problem. Evidently the Ensign has forgotten the moral to the story of Columbus and his egg trick and simply because it is beyond his comprehension as to how it could be accomplished, is not prima facie evidence that it could not be done. It will doubtless be surprising to the Ensign to learn that already extensive experiments are being conducted with a variable pitch propeller which I understand can be changed to any pitch desired, even to the point of reversing, while it is in motion. I do not claim to know how this is done, nor would I venture an opinion as to its practicability, but some one "higher up" must have conceived that such a thing lay within the bounds of possibilities as the War Department has issued a call to inventors to produce such a propeller.

Why does not this self-styled authority on aerobatic flying come forward with the exact formula for "making effective use of his controls and bringing a machine out of a spin," and thereby save the lives of his fellow flyers who are still meeting their untimely end and through the lack of this "technical knowledge"?

In reply to Ensign Pratt's sarcastic reference as to my "extensive acquaintance with aeronautical affairs," I will state that it might be of passing interest to this esteemed gentleman to know that I have been interested in aeronautics in all its branches for the past nine years: that I was the first man in Texas to build and successfully fly a Texas built airplane: that I was the first man to enlist in the Officer's Reserve of the Aviation Section, passing all the mental and physical examinations with the exception of a slight defect of vision, hence the "slight advantage" mentioned by this learned dispenser of "Airplane Facts and Fallacies." I have letters in my possession that will bear me out in the assertion that I discussed the subject of aerobatic flying with the promoters of the great aviation meet held in Boston in July of 1912. I offered to go to Boston and demonstrate that looping the loop in an airplane was entirely practical. True I had never accomplished this feat but I was so certain that it could be done that I was willing to try it if they would sufficiently compensate me for the demonstration. As a result I was ridiculed and classed as a fanatic. This was almost a year before Pegoud, the daring French aviator proved my theory to be correct.

"To recapitulate" as the Ensign puts it, his one great concern seems to be that for such naive articles as "The Nose Spin" to appear in the widely circulated periodicals, such as the SCIENTIFIC AMERICAN, "without refutation," would tend to increase public prejudice against the airplane and that planes will be of little value commercially until this popular superstition is dispelled.

I heartily agree with Ensign Pratt that at present airplanes are of little value commercially but I am forced to take issue with him as to the exact cause. Between the two factors of popular superstition and initial cost and upkeep, I am of the opinion that the latter presents decidedly the greater of the two obstacles, and until some other form of power is evolved they will continue to be of little value commercially except in ventures where the tax-payers are called on to bear the brunt of the burden of expense. This view, I believe, I share with a number of eminent authorities on the subject.

GEO. W. WILLIAMS.

Temple, Texas.

Replacing the Campaign Hat with the "Overseas Caps"

A SPECIAL cap, officially known as the "over-seas cap," is now being worn by the soldiers of the American Expeditionary Forces. The cap not only is more practical than the regulation campaign hat worn by the soldiers in this country, but adds to the safety of the men while in the trenches.

The new cap matches the uniform in color, is round, and has no brim or peak. The crown is very low and made so that when not in use it can be folded and carried in the pocket.

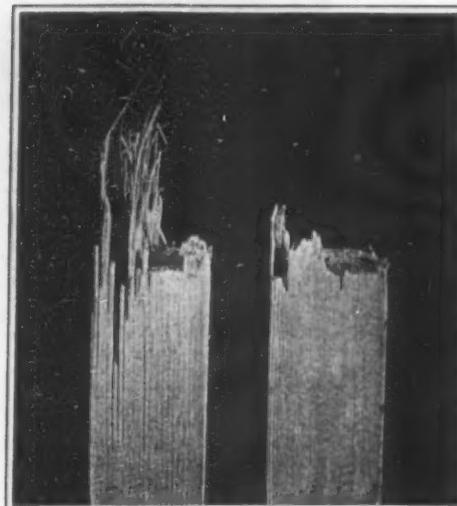
When the Americans entered the trenches it was found that the brim of their campaign hats interfered with sighting through the trench periscopes and that the high crown, in the case of tall men, could be seen above the parapets. The new cap is so low that it permits the men to move with the same freedom as when they are hatless. Another advantage claimed for the overseas cap is that the trench helmet can be placed on top of it with security.

The latest model of the cap which has just been received by the manufacturing branch of the Quartermaster's Department is slightly different from the cap worn by the troops returned from France. Slight changes have been made in the crown which permit its being folded flatter and thereby enabling it to be carried or shipped without injury to the cap. The new model will be substituted for the old as fast as practicable, but it is planned that a gradual substitution be made so that the production will in no way be slowed down.

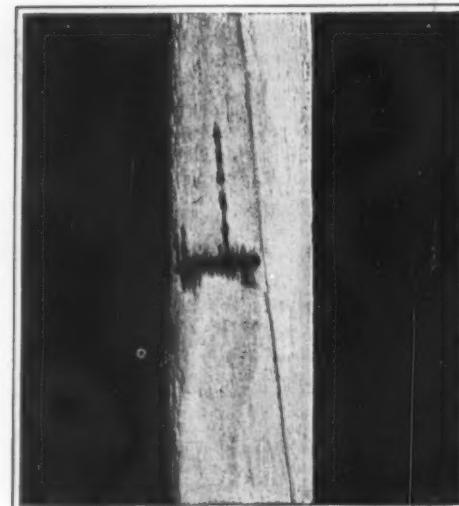
Only soldiers who have been with the Expeditionary Forces wear this cap. It is not issued in this country, although made here. Reports received from France say that new regulations provide that officers shall wear the insignia of their rank on their cap. Enlisted men are to wear on the cap the button prescribed to be worn on the left-hand side of the collar of the service coat.

Rooks Kill Sheep in New Zealand

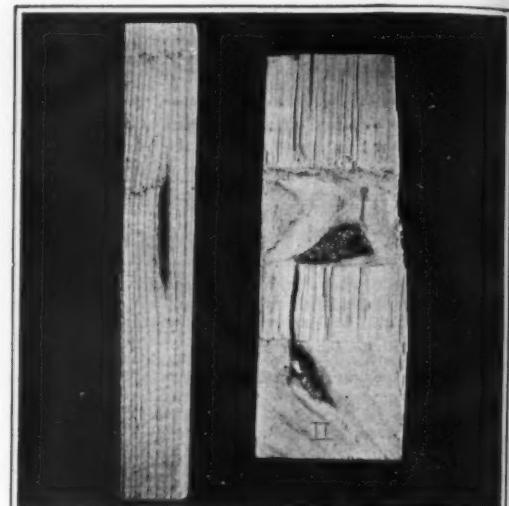
A PARALLEL to the development of abnormal habits in the Kea parrot of New Zealand, originally a vegetable feeder like other parrots, which has taken to a flesh diet since the introduction of sheep, is now afforded by the imported rook. In the Hawke's Bay district of the North Island the rooks have taken to killing lambs and even full-grown sheep by attacking their throats.



Brashness is indicated by the square break at the right, toughness by the splintered one
(Both specimens Sitka spruce)



Testing for direction of grain by observing the course of the ink as it runs into the pores of the wood



Pitch pockets, a very common defect in spruce, are difficult to detect unless of some size or located near the surface

Defects in Airplane Woods

Judging the Quality of the Timber That Goes into Our Fleet of Fliers

By Samuel J. Record

THE wooden components of an airplane represent the "survival of the fittest." The process of elimination begins with the species and follows through all the various stages of manufacture and assembly. One kind of wood may be rejected because it has a bad reputation while another is passed by because its properties are unknown. Thanks to the long series of laboratory tests made by the United States Forest Service, this war did not find us unprepared so far as a working knowledge of our own woods is concerned. Unfortunately this cannot be said for the products of the vast forest regions beyond our southern boundary.

Merely to enumerate the species used is to tell only a part of the story of wood selection. While every species tends to preserve certain racial characteristics, and to produce woods of a certain sameness, yet each tree within that species possesses a distinct individuality. Wood is a natural product, a structure designed to meet the needs of the tree, not of man; a structure which, in detail, is as infinitely variable as the conditions which combine to produce it.

Accordingly, wood is not amenable to refinements of standardization. In this it differs from many other structural materials such as metals and concrete. There are, to be sure, tables giving unit strength values for woods; but these are merely averages of many tests and are not directly applicable to any given piece of material. They serve many useful purposes, however, not the least of which is to provide a basis for comparison.

In selecting wood for a particular purpose one of the fundamentals is to be able to correlate strength values with features which are readily discernible; to know the signs of strength and the signs of weakness. The best criterion of strength is the weight of the dry wood. The substance composing the cells weighs about 1½ times as much as water and is practically uniform for all species. The more wood substance per unit of volume or the greater the density of the material, the harder and stronger it will be.

Since lightness is a desirable property in airplane construction it might be assumed that the less weight a given specimen of wood has the better. There is, however, for every wood a certain minimum limit beyond which reduction in weight is attended by brashness and brittleness. The wood produced late in the life of an old tree is almost invariably light and brash, with little reserve strength beyond the limit of elasticity. Wood immediately surrounding pith, sometimes erroneously called the heart, is invariably weaker than that further out. Sometimes ash, normally one of our strongest and toughest woods, is so punky and brash as to be absolutely useless for any purpose requiring strength. Kiln drying at too high temperatures will induce permanent brittleness in wood. There are various methods for detecting brash or brittle material. Abnormally light weight is an almost certain indicator. The nature of the fracture when a specimen is broken in bending is another. A tough wood will give way gradually, with a fibrous or splintery fracture, while a brittle one will snap off short without warning. The same effect can be approximated by gouging the surface of the wood with the point of a knife and noting whether it splinters or "picks out" punky.

Wood is at its best for most purposes when the grain is straight, that is, when the fibers lie parallel to the long dimensions of a stick. In such material the shrinkage is more uni-

form throughout and the tendency to warp out of shape in response to fluctuations in the moisture content is at a minimum. Whenever a wooden part is deformed by an external force, as in bending, a portion of the material is stretched, and the resistance offered when this tensile stress is along the fiber may be more than 50 times greater than when the pull comes across the grain. This ratio is increased enormously if the lateral continuity of the fibers is interrupted by splits due to seasoning and other causes.

Another form of cross-grain is produced in lumber by the method of sawing and has no reference to the natural arrangement of the wood elements. If a log is approximately the same diameter at each end the plane of the saw must be parallel to the axis of growth, while in logs with decided taper, the plane of the saw, for the outer planks at least, must follow the outer edge and not the middle of the log. Otherwise the growth rings will be cut across diagonally and the timber weakened accordingly.

Another source of local cross-grain is knots. The bigger the knot the greater the range of the disturbance. It is largely on this account that knots are such serious defects, though they also interfere with the cabinet qualities and are always disturbing factors. There are also various local irregularities which cannot readily be accounted for, though due in some cases to unevenness in the surface of the tree and to injuries. The "blister mottle" which occurs in yellow poplar is believed to be due to injuries caused by sapsucking birds. These also produce "bird-peck" and "rust streaks" in hickory. Some spruce logs show on the outside beneath the bark long narrow furrows of unknown origin, sometimes called "bear-scratches." The wood shows undulations in the growth rings on the ends and peculiar vermiform markings on the surface. They have been mistakenly ascribed to mistletotoe.

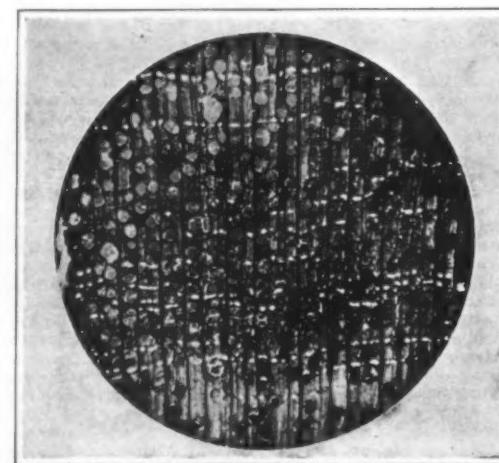
The surest way to detect any kind of cross-grain is to split a piece of the wood and note how the cleft runs. It must be remembered, however, that normally there are two planes of cleavage in wood, one following the rays, the other following the growth rings. A stick may be straight-grained so far as one plane of cleavage is concerned and diagonal with respect to the other. When the rays and vessels are large enough to show prominently, as in oak, the direction of the grain is easily noted. In some woods it is shown by the roughing of the fibers under the planer, and by the way in which the light is reflected, an effect very noticeable in mahogany.

In conifers, such as spruce, and in fine-textured hardwoods, like yellow poplar, the rays and wood fibers are so small that it is often difficult to determine their direction, even with a hand magnifier. This is particularly the case when the specimen is cut quartering, that is, with the growth rings running diagonally across the ends. Splitting, of course, would spoil the specimen. In such cases, the ink test is fairly satisfactory. A pen is drawn across the wood and the ink spreads along the fibers. The pen is then touched to the end of one of these spreading lines, causing it to run further. By repeating this process a few times a line

is formed long enough to permit measuring the angle the grain makes with the axis of the piece. If this line deviates more than 1 inch in 15, 20, or 30 inches, depending on the class of material inspected, the specimen is not acceptable. In a wood with resin ducts, as in spruce, pine and Douglas fir, the longitudinal course of the ducts on the tangential surface is usually distinct enough to show the direction of the grain.

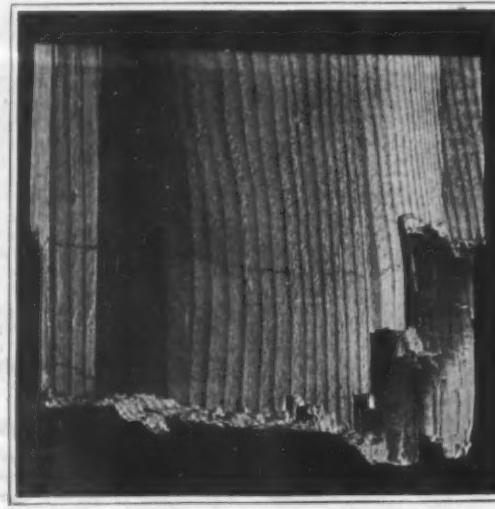
It is not generally known that wood is often broken in the tree without any outward indication of the fact. Areas of compression failures result, usually in connection with some weak place such as a knot or other defect. Just what causes these compression failures, sometimes designated "heart breaks," is not definitely known, but they may result from severe wind storms or more likely

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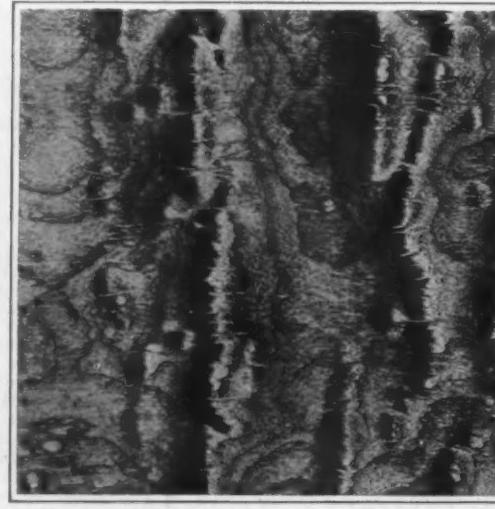


Smooth end of Philippine mahogany, under the glass, shows characteristic rows of white dots which distinguish it from true mahogany

There are many factors which interfere with straightness of grain. Some trees have their fibers arranged in a spiral direction and produce what the English term "torsæ" wood. Spiral grain is the source of much trouble in the use of spruce. The direction and pitch of this spiral are subject to change, sometimes at such regular intervals that a so-called "ribbon" or "feather" grain is produced. This is very common in mahogany, prima vera, and tangue, but owing to the fact that these woods are used in laminated construction the ill effect of the irregular grain is largely overcome.



Section of spruce wing beam cut from wood which was broken in the tree, probably when felled



Blister mottle in yellow poplar, believed to be due to the pecking of holes in the live tree by sap-sucking birds

The Government's Emergency Construction Contract

A Flexible Agreement Adapted to the Exigencies of War

By Col. W. A. Starrett, U. S. A., Chairman of the Committee on Emergency Construction, War Industries Board

IN these piping times of war, when the money that belongs to all of us is being spent with such a lavish hand, even so stodgy a thing as a contract may take on new interest. We see the prodigious things being done all around us and we naturally inquire by what instrumentality the interests of the Government are being safeguarded, and what the duties and responsibilities of the people are who are thus entrusted with these great undertakings. The problem itself—the building program—was discussed in a former article and it was there seen that the matter summed up in the fact that the Government and the contractor had to go into the field together to start the work immediately and develop the details as they went along. New problems had to be met and solved, there was no time for prior study or introspection. "Do it, and do it right away," was the slogan that got our tremendous building program under way almost immediately upon the declaration of war.

Even a person in dire necessity and distress may properly ask his technical adviser what he is going to do and something about how he is going to do it; even the terms and conditions under which the thing will be done may properly be examined. In a word, it is proper to inquire what the contractual relations are to be.

Before going into the question of the contract it might be well to review what the modern contractor really is. So many people are apt to look upon him as a sort of a merchant who has the parts of buildings for sale, and, who can if he likes, make low and attractive prices on a composite of these wares called a building, to suit the convenience or the bank account of his customers. In reality he is nothing of the sort. To the extent that he purchases building materials he is only a broker who pays about the same price for the materials as the owner could buy them for direct. In the estimation of the productivity of labor he has had wide experience based on his skill in dealing with that fickle commodity, and in this he has an advantage over the owner. However, it is in his skill in so maintaining the great complexity of a building operation that there will be the greatest possible economy of result that he makes his profit. The limits between actual cost and what would be recognized as an exorbitant price are surprisingly narrow. In other words, there is no exorbitant profit in construction work.

Few people realize the changes that have taken place in the science of building in the past decade. Nowadays structures are so complex on account of the highly developed heating and plumbing and lighting facilities, the demands for nicety of finish, the requirements in all the little details of special design, the demand for rapid construction, the limited space in which work has to be carried on, the necessity for carrying on dozens of operations simultaneously, and last of all the high priced and highly segregated building trades labor, that the modern builder must be an expert of the very highest order if he is to be successful.

Thus, when building is suggested the builder is entirely ready to bid, but the owner and his advisers may not be so fully prepared. "Just what do you want?" becomes a very pertinent question, and the owner is immediately on the defensive unless he has had a long time to study the problem under the direction of a competent architect or engineer.

And here we have the crux of the matter when it comes to the Government's emergency war work. The builder is ready, but the Government is not, and yet the work has to proceed. Bidding is out of the question, unless the Government wants to unload the risk of its own indecision on the contractor, and in so doing what a price it must pay! The contractor ready, equipped, organized knowing his ground; the Government unready and subject to the violent changes of plans that war itself induces. What, under these circumstances, would bidding lead to, but enormous profits and even scandal.

But this was not an entirely new situation to the industry although the war emergency was on a vastly larger scale than any that had ever before arisen. Indeed the very complexity of which we have spoken had engendered an equitable system which had come into pretty general use on large commercial work whereby the owner carried his own risk, at the same time getting the benefit of the contractor's organized skill. The owner and contractor joined in a sort of honorable partnership under which each bore the risk that was appropriate to his end of the bargain, and through years of practice this procedure has come to be considered the very highest form of contracting. Only the firms of highest integrity, with strong organization and expert executive ability, long survive the exactions of this form of contract which is

THIS is the second of a series of four articles dealing with the Government's vast building program. The first of the series appeared in the issue of September 7th. The third article will tell of the organization for the supervision of building work, and the fourth will deal with the subject of recommending a contractor.—EDITOR.

generally known as percentage work. For now it is the owner's own money that is being spent and somehow the owner has a new interest awakened—he is carrying his share of the load.

The War Industries Board was quick to see these elements in the Government's situation at the outset of the war and it immediately set about devising a contract that would fit the conditions that were sure to be encountered. It called to Washington the leading men in the industry and conferred with them. It took the advice and weighed it and compared it with the necessities that would arise from the various bureaus. With the aid of its legal department and in consultation with the officials of the Controller's office, the Treasury and the

vides for the checking of all payrolls by the Government and the auditing of all vouchers. It establishes all of the safeguards that are necessary, and yet it aims not to restrict the contractor in the free application of his expert knowledge. To be supervisory and administrative is the function of the Government, to be executive is the function of the contractor.

And the compensation is suited to the responsibility. In the first place the contractor may not charge to the cost of the work his "overhead"—the cost of doing business. He may charge only the expense actually incurred at the site in the performance of the work. Then there is the compensation itself. It starts reasonably low—seven per cent on small operations and scales down as the amount of the work increases. Work involving a million or so pays about 5½ per cent, and so the fee decreases till we find that on jobs of \$10,000,000, 2½ per cent is paid. But that is not all. Regardless of the size of the job, the contractor is not allowed to make a fee in excess of \$250,000 on any one job. Some of our jobs border on twenty million dollars and, under the circumstances, the contractor gets about 1½ per cent. Such concerns as are able successfully to handle work of this magnitude are the strongest and most highly organized. Their annual overhead is apt to be close to the amount of this maximum fee. Nevertheless there is sound theory in this limitation, for in dealing in such vast sums the standards of peace times largely disappear and we are in reality hiring practically the entire services of the contractor.

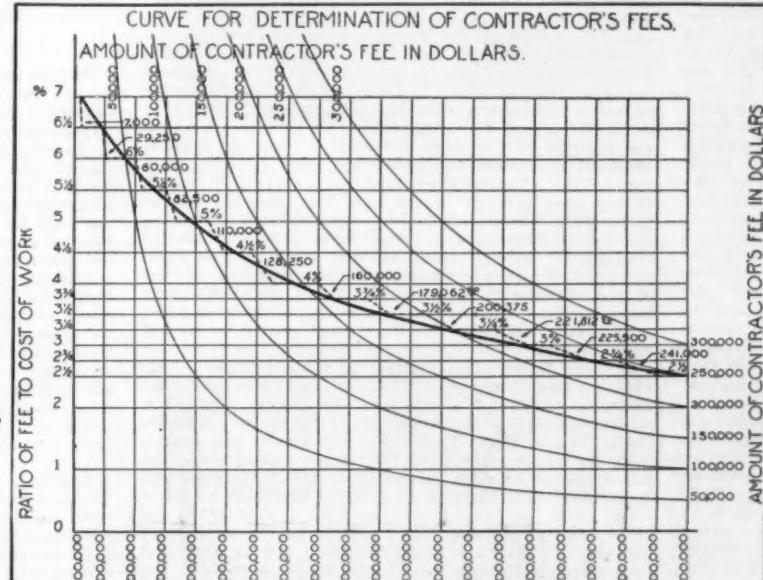
We are so used to talking about fees and safeguards that we are apt to forget many of the other essentials of a contract. What about tools? What about an accurate description of exactly what goes to make up cost? What about accountability, payments, abandonment of work, termination of work, changes, right to discharge the contractor for cause, Government labor regulations, settlement of disputes and a hundred and one things that are apt to come up? The answer is general; they are all taken care of—all equitably to the Government and to the contractor. The very turning over of the executive power to the contractor puts reciprocal supervisory and administrative powers in the hands of the Government.

It will be seen that all of this is designed to facilitate quick action, but it may not be so clear that the great underlying advantage to the Government is control of its own work, control at all times. And, if there is one great essential in this war crisis it is that the Government must have at all times complete control, freedom of action to change its mind as frequently and as violently as it wishes with none to say it may. Thus it is that in the violent upheavals that are constantly occurring we are freed from the drag anchor of always having to consult the contractor before arriving at conclusions that in war, of all times, must be made decisively with as little hindrance as possible.

To emphasize the point consider those conditions of change under a fixed price contract. Now it is the contractor's money and rights and prerogatives that you are dealing with. He it is that has to be reckoned with on every change and every decision. In equity his estimates have to be obtained in advance, which means advance detailed knowledge of every contemplated change. Then there is the haste. We may be willing to wait and argue it out, but the Germans won't. The Government is the suppliant, not the contractor, who at all times stands ready to carry out his original bargain.

Advocates of fixed price contracts in these piping times of war are wont to inform us that they can introduce conditions into their contracts that will take care of all these contingencies. So they can, and reams of qualifying clauses are introduced into specifications for all of which the adroit contractor adds to his bid. Most of them never happen in just the way they ought to, so the contractor pockets the proceeds of his gamble. On the other hand unexpected contingencies have an uncomfortable way of happening outside the pale of these far flung qualifying clauses. In reality these contractual safeguards are against ourselves as fickle and capricious owners and not against the contractor who at all times stands with his feet squarely planted on his original platform, viz., that he is ready and willing to perform what was originally agreed, but if changes arise with the Government, than let the Government pay the piper.

In these war times the Government has taken over pretty much of the right of trade and barter both in regard to labor and material. Under the standard emergency form of contract here discussed, this fits perfectly (Concluded on page 219)

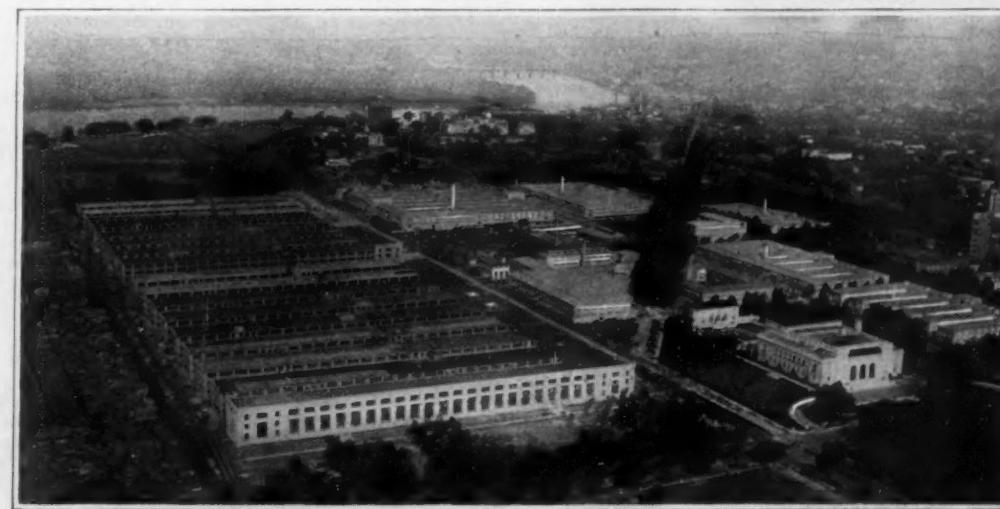


Decrease in contractor's compensation as the cost of the work increases

To find the approximate percentage to be paid for a contract of any given amount, find that amount along the horizontal scale at the bottom of the chart, run vertically to the heavy curve and at the point of intersection will be found the horizontal line corresponding to the percentage of fee for that given amount. The heavy curve is the theoretical line of reduction, but to avoid complicated computation the percentages are charged at stated intervals, hence the practical application will be found in the irregular line which closely follows it.

Judge Advocate General's office, it devised the form of contract that is now in general use throughout the Army building program.

The theory of the contract is simplicity itself. It assumes that the contractor is a high class, efficient, well organized expert of established integrity. It, in effect, tells him to obtain from the Government's representative necessary instructions and under the direction of that representative to proceed at once with the buildings, applying to the problem all possible skill to the end that the work will be done as quickly and economically as possible. But that is not all. It takes complete supervision over his activities, so that he may not buy so much as a pound of nails or a foot of lumber without the sanction of the Government's representatives. It pro-



Probably the two largest office buildings in the world

Concrete structure for the Navy and the War Departments. They contain nearly 2,000,000 square feet of office space. The buildings to the right in the background are the Council of National Defense, the Food Administration, the War Trade Board, etc. Altogether over 3,000,000 square feet of office space is contained in these buildings.

World Markets for American Manufactures

Edited by LYNN W. MEEKINS

A department devoted to the extension of American trade in foreign lands

The Market and the Merchant

MODERN exporting is a game played under generally recognized business rules in the international field. Comparatively new among the great nations of the world, the United States has only recently graduated from the amateur class and gone into the contest in a professional way. Until the world war broadened the scope of our commercial transactions, most of our manufacturers were satisfied with their success in the domestic market, and many of those who sold their goods abroad had two objects in view—to dispose of their surplus output, and to obtain the higher profits accruing from foreign orders. England and Germany, on the other hand, dependent upon exporting for their economic existence, took it up in a scientific way and built the substantial trade which enabled them to rank among the great powers. Since the United States has become the world's greatest source of supply, our manufactures have developed to such a degree that we shall face an industrial revolution after the war unless our foreign trade is extended so vigorously that we shall be able to compete with our present Allies and with the Germans when they are again in the field.

A Discouraged Exporter

In order to do this we must find out exactly what our customers want and enable them to buy from us with the greatest possible facility. Several years ago, an American manufacturer of plows and other agricultural implements sent one of his best men to Mexico to find out how much business could be done there in his line. Neither the manufacturer nor his representative knew anything at all about foreign trade, and except for glancing through a commercial geography and a few guide books and railway schedules, which gave them an idea of the principal agricultural districts of the country and enabled them to map out an itinerary, no preparations were made for the trip. "Just go down there and look around," were about all the instructions the representative had. He spent several months in Mexico, visiting the principal cities between the Texas border and the capital. Then he went to Vera Cruz and returned to the United States on board a ship that carried him across the gulf to Galveston. "Not much of a market," was his verdict. "Most of the farming is very primitive, the old Egyptian wooden plow being extensively used. There are plenty of draft animals. Labor is abundant and cheap. I don't think we can sell very much in Mexico." The manufacturer wanted to get back the several thousand dollars spent on the investigation, so he arranged with a half dozen Mexican importers to handle his plows, mowers and reapers on a commission basis, sending a small quantity on consignment. The results were very disappointing because the Mexicans, never having seen such implements, did not know how to use the modern implements, and the dealers, who also handled many other classes of goods, did not try very hard to sell them.

The Right Way

In contrast to this may be cited the experience of another American manufacturer of greater forethought. Upon learning of Mexico's primitive agricultural methods he tackled the problem in two ways. First, interesting the Mexican government in improving the development of the country, and second, showing the farmers why it would pay them to use modern implements. The representative that he sent was a man who had spent many years in Mexico and had an intimate knowledge of the people and their customs. He took with him implements and machinery for demonstration purposes and catalogues in Spanish describing their advantages and containing explicit directions for their use. During his visit there began a great trade upheaval, caused by a series of revolutions, and his work did not result in immediate sales of any considerable volume. But he aroused a great deal of interest in his company's products and selected number of wide-awake dealers to act as agents for them. When things quieted down, there ensued the usual changes that follow political disturbances. There was no longer an abundance of cheap labor, and the number of farm animals had materially decreased. To obtain much needed revenue the Government began to impose heavier taxes upon the owners of estates, which made necessary an immediate stimulation of production. The Government readjusted the duty on agricultural implements and the railroads reduced the freight rates applying to them, so that the manufacturer who had looked ahead was able to sell his goods in large quantities and eventually build up a considerable volume of sales.

American Flags Made in Germany

Germany and England succeeded in the export field because they met very carefully the requirements of each market and had their representatives on the ground to handle the business, together with an adequate merchant marine to carry their products across the sea. Because of the war, it has been possible to introduce many lines of American manufactures into foreign countries that would never have taken them under normal conditions. When a man can not get what he wants, he takes the nearest thing to it, but after the war the American exporters will have to give him what he wants or lose the trade to their competitors. Towards the end of 1916, when Germany had become very unpopular among loyal Americans, the representative of a German firm traveling in South America was unusually persistent in his efforts to sell his goods to a house in Brazil which did not have much sympathy for the Kaiser. He was so determined to make a sale in spite of the manager's attitude that he refused to be denied, and in order to get rid of him the firm gave him an order for a dozen American, British and French flags. These were duly supplied by the German

manufacturer whom he represented. It is hardly likely that an American salesman would undertake to supply any German flags at the present time even if there were a demand for them. But our foes are animated by no patriotic scruples when it comes to business.

German Methods in South America

German merchants in Venezuela laid in a very large stock of all sorts of merchandise when they saw the approaching scarcity of shipping, and realized that the war had a long time to run. Employing the barter system, they are now exchanging their goods for Venezuelan coffee and other products, which they are storing for sale after the war. Regardless of the outcome, German traders will be ready when the international market is again open to them. To retain our foreign customers we must do business their way and not insist upon having our own. American rapid-fire methods will not succeed in countries where both life and business are conducted along easy lines.

A recent visitor from Colombia explained why Germany has extended the longest credits of any exporting nation. When a German firm sends a man down there, he does not run to a hotel, arrange a display of samples and take the leading merchants in taxicabs to see them. His entrance into the field is leisurely, and to all appearances he comes to Colombia as a tourist on a pleasure trip. He makes all the friends that he can and investigates thoroughly the standing of the principal firms, collecting casually valuable information through informal conversation. In many cases representatives of German concerns intermarry with the natives and enter into the daily life of the community, all the time keeping the interest of Germany foremost. Then they know what firms to sell to and how much credit they are good for, so the chances they take are exceedingly small. It has been difficult in the past for American manufacturers to obtain satisfactory representatives, because the United States has not evolved so good a system of training for foreign trade as that used by our competitors. We have emphasized the theory at the expense of the practise. Although the broad principles may be gathered from books, the real problems can be solved only through the experience gained in actual transactions.

Foreign trade is an interesting game because of its everchanging variety. Each market has different features. Although China has the largest population of any country in the world, we sell fewer automobiles there than in Porto Rico. For the former has practically no roads outside of the larger cities, while the latter has an excellent highway system. It is natural to suppose that children in tropical countries go barefoot. And yet American sales to Cuba of shoes for little folks were greater last year than our exports of footwear for men and women. There are no hard and fast rules in foreign trade, and to be successful the manufacturer must be a close and faithful student, capitalizing his experience and getting his customer's point of view.

Little Things Count

DETAILS are important in handling foreign orders," said an exporter of many years' experience. "It is a difficult matter to correct mistakes because the shipper and the consignee are generally thousands of miles apart and a great deal of time is required. The customs officials in many countries search eagerly for slight discrepancies in the shipping documents, for heavy fines are imposed if the invoice and the other papers are not in accordance with the regulations. Last winter an export commission house in New York sent a consignment of cotton laces to the West Indies. Some of the goods came from England, where they are sold by the dozen yards. The remainder formed a part of the stock on hand which had been obtained from American manufacturers and were sold by the yard. In making up the invoice covering the West Indian dealer's order, the shipping clerk copying the bills for these two lots omitted the word 'dozen' from the English items, although the values and all other details were correctly stated. When the cotton laces arrived in the West Indies they were immediately seized by the customs officials and the export commission house was notified that a fine of \$1,000 had been imposed. The shippers enlisted the aid of the American consul and promptly submitted proof of the inadvertence of the error and the lack of intent to avoid payment of the full amount of duty to which the goods were liable. The case was carried to the court of customs appeals, but the fine stood.

"An official of one of the larger express companies told me the other day that a shipment of tea from Formosa came in recently consigned to a firm about which little seemed to be known in business circles. The exporter had failed to sign the bills of lading. With \$10,000 worth of tea on its hands the express company was in doubt as to what should be done. It happened that the consignee, who was the Formosan grower's American representative, had been in this country only a short time and had established neither banking nor trade connections. He furnished, however, sufficient evidence to indicate that he was entitled to the tea and that the carrier could turn it over to him with a reasonable degree of safety. But for the willingness of the express company to assume the risk, serious difficulties would have arisen for both the exporter and the consignee. This instance shows the necessity of examining carefully all documents before sending them forward.

Terms Should Be Definite

"Of all the misunderstandings that arise between buyer and seller none are more vexing nor more apt to create bitter feeling than differences over terms. Es-

specially is this true under the conditions now prevailing in international trade. The fluctuations are so frequent and so wide in practically every element of cost—the price of the goods and freight and insurance rates—that unusual care should be exercised in making quotations and in booking orders. A concern in India wanted to buy some chemicals and asked us for our best prices. In replying we named the current quotations and stated that they were subject to change, and any orders that we might receive would be filled at the best price for which we could supply the goods. It takes a long time for a letter to go from New York to Bombay and it was several months later when we received a cable order for a small quantity of caustic soda. There was so little profit in it for us that we didn't feel justified in cabling an acknowledgment, but we wrote immediately, informing the buyer that we were sending the chemical, for which we charged the lowest price consistent with that day's market. The firm in India was greatly incensed because the market had risen and it had to pay a little more than it had expected. To make matters worse the caustic soda was delayed in transit and had deteriorated in quality before it could be delivered. The lessons that we drew from this experience were not to fill any orders without confirmation by the buyer and his clearly expressed understanding of our selling terms.

Misfit Flooring

"Close attention to details is a prime requisite for success in exporting. It is easier to be careful than to pay for the damage caused by carelessness. A wealthy Argentine wanted parquetry floors for his new house in Buenos Aires. The order came to us, and we arranged with a manufacturer to ship the flooring direct. At that particular time few vessels were available and if the material missed a certain steamer it would be held up for nearly two months. This fact was impressed upon the mill and in their eagerness to get the flooring away on time they sent the wrong sizes. The gentleman in Buenos Aires was not slow to express his dissatisfaction, writing that he could not build his house over again to make the flooring fit. Fortunately we arranged with our representative in Buenos Aires to dispose of the shipment to another customer. By a seemingly trivial slip an exporter may not only injure his own prospects in a foreign market but also create a bad impression of American trade methods in general."

The Friendly Australians

IN a long talk on American trade with various countries, made at a largely attended meeting of business men interested in export matters, the speaker failed to refer to Australia. This omission grated upon a young man in the audience, a well set-up fellow recently returned from active service in Europe, and he seized the first opportunity to remind those present that Australia is very much on the map.

"I have been asked a dozen times since I have been in the United States what language we speak in Australia," he snapped. "Why don't you people here take the trouble to find out something about us? We speak English; we are not foreigners; we are your comrades in arms, your brothers, and we want to do more business with you. Australia is not going to buy any German goods for at least five years after the war, and even longer, I hope."

It was suggested that the pictures of Australian aborigines found in the geographies of past decades had given to many Americans the impression that the Commonwealth is a wild country peopled mostly by savages.

"Then you ought to burn those geographies and wake up to the fact that the area of Australia is as great as that of the United States, and all we need is a larger population. We have done pretty well so far, producing more wool than any other country in the world, and forging right ahead in agriculture, mining and manufacturing. Australia wants to buy American goods of all kinds. Our country is very much like yours, and we wish that you would take more interest in us."

He added that a firm in Sydney received a letter from an American concern addressed like this: "Browne and Whyte, Ltd., Sydney, Australia, corner of the Pacific and the Indian Oceans," and commented dryly that the reply might just as well have been directed to "the United States, Western Hemisphere."

Despite the shortage of ocean tonnage there has been a steady gain in exports from the United States to Australia during the past five years. A great many Australian buyers have come here. Some of the American products that have been found particularly well adapted to conditions in the Commonwealth are axes and cross-cut saws, stump pullers, farm implements, automobiles, and many manufactured goods. For its population Australia is the best market in the world for the wares of American merchants, its five million people buying about twice as much from us as the four-hundred-odd million of China.

American Chamber of Commerce in Mexico City

THE establishment of an American Chamber of Commerce in Mexico City on November 8th, 1917, marked the inception of an American propaganda in Mexico of great weight and influence. The organization was formed by American citizens residing in Mexico City for the purpose of promoting international trade and furnishing reliable channels of communication. The Chamber is trying to meet German activities in Mexico and at the same time is preparing for future expansion. Interested Americans should address the Chamber at Apartado 82 bis, Mexico City, Mexico.

A German Substitute for Browning Rifle

WHILE the idea is by no means new, a combination rifle-pistol recently taken from the death grip of a German officer who fought our men to the very end, is of interest because it serves about the same purpose as our Browning rifle. In fact, for want of something better it may be the German counterpart of our automatic shoulder piece.

The captured weapon, which is depicted in the accompanying illustrations, is owned by Private Claude Green, a newly-arrived patient at the Walter Reed Hospital. It consists of a German automatic pistol of a type often found on enemy officers, and a wooden case or holster made in the form of a gunstock. When not in use the pistol is carried in its wooden holster which swings at the side of the officer. The pistol can be used as a pistol or, by attaching the wooden case, as an automatic rifle. When used in the latter manner it appears to be a somewhat poor imitation of the Browning gun which, the chances are, weighs little more, but certainly carries more ammunition at one loading and possesses greater range and accuracy because of its long barrel.

Chloride of Calcium in the Fruit Store

IT has for long been known that fruits, such as apples and pears, keep best of all in a dark place free from temperature variations. But stored fruit sweats to a considerable extent and this causes an undue amount of moisture in the atmosphere. If some of the dampness is not removed the fruit suffers from rotting. As a rule the air is dried by the admission of currents of air but the draught may bring about a harmful degree of cold. Some experiments carried out in France have shown that closed fruit stores may be rendered safe by the use of chloride of calcium. This salt has the property of absorbing moisture from the atmosphere to the extent of about double its own weight. In fact, it deliquesces, absorbing enough water to dissolve itself, so that after exposure to a damp atmosphere it will eventually become quite liquid. It was shown that the atmosphere of a fruit store could be kept on the dry side by the periodical introduction of chloride of calcium. The chemical is placed in a shallow trough with a lip. This is tilted upward so that as the chloride absorbs the moisture and becomes liquid it can drain away into a vessel placed beneath. The salt is renewed about once a week. The chloride of calcium can be rescued again and again. It is only needful to place it in a vessel over a fire and in the way evaporate the moisture. When quite dry the salt is ready for use again.

Grinding Coffee by Water Power in the Italian Army

THAT the Italian soldiers have not been behind those of other nations now at war in the matter of ingenuity, is evident from a glance at the accompanying illustration.

Here two Alpini, or special mountain soldiers, are seen grinding coffee by means of a crude water-wheel arrangement. They have harnessed one of the numerous mountain streams the power of which is now grinding the coffee beans for an entire company of Alpini, relieving some one soldier from the tiresome task of grinding away for a long period.

A Duel Between British and German Submarines

FORMERLY, it was believed that, because of the impossibility of submarines sighting each other when they are entirely submerged with the periscope below the surface, it would be impossible for vessels of this type successfully to attack each other—in other words, it would be a case of the blind searching for the blind. The events of the war, however, have disproved this; for there have been several cases au-

thentically recorded of the destruction of submarines by submarines. Moreover, these vessels have proved to be most serviceable for scouting work, not only against surface ships but against those which make their attack below water and unseen.

hour, each boat maneuvering for a favorable position to attack the other. The British boat let go a torpedo, which missed; but three minutes later a second torpedo struck the German close to the stern. The U-boat made a desperate effort to get to the surface and showed her conning tower, smoke meanwhile pouring from the stricken vessel. A few seconds later the bow rose vertically in the air, and the U-boat took a perpendicular dive, leaving a heavy slick of oil upon the surface and a whirl in the surface of the sea, indicating the rush of water into the broken hull. The boat shot down like a plummet, leaving no survivors.

Toluol from a New Source

ANOTHER source of toluol, that indispensable product for making high explosives, has been found. It can be produced from spruce turpentine, an oil formed during the cooking of the chips in sulfite digesters. It escapes with the steam in the blowing out process and is generally allowed to go to waste, though processes of recovering this crude form of turpentine are carried out in a few mills.

A representative of the War Department has explained the need for toluol and has estimated that 300,000 gallons could be obtained from the mills in the United States at very little expense. He points out that it is a patriotic duty for all the mills to install the apparatus to recover this spruce turpentine and ship it to a central refining plant, if the War Department finds it desirable after investigation. A committee of the Technical Association was appointed to co-operate with the War Department in ascertaining the supplies of spruce turpentine that are available in this country for toluol manufacture.

While the total quantity of toluol, as estimated, is not large, considering that 3,000,000 gallons were recently put under contract within six weeks, still every available gallon helps and all sources that promise results must be developed.

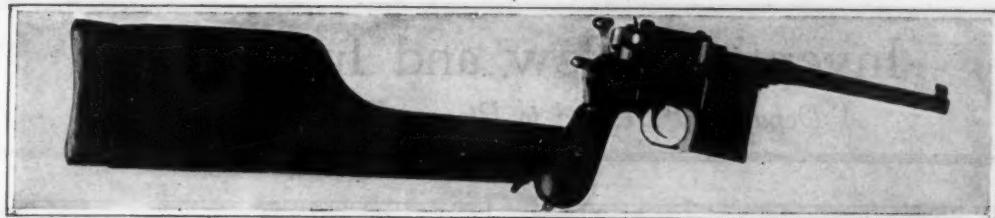
New York's Winged Policemen

DESPITE the three thousand miles of water and the hosts of Allied and American troops which stand between the enemy and ourselves, the possibilities of an aerial attack on such coastal cities as New York have not been overlooked since our entry in the great war. We have given the German full credit for his ambition and his frightfulness; and the authorities have long ago taken proper precautions to defend our eastern cities against enemy aircraft which might find their way to our shores by various possible, if improbable, means.

Of the several measures taken by the authorities with regard to the defense of New York City, which, aside from the national capital, would be the most likely target for a German transatlantic raid because of the significance and universal renown of that metropolis, is the recent formation of the Aviation Division of the Police Training Corps. As yet, little information is available concerning the activities of this unique defensive body.

Several hundred young men have enrolled in the Police Training Corps, from nearly all occupations in the city, for the instruction and training given. Some are receiving military training while others are receiving aeronautical instruction, the latter being financed by Special Deputy Commissioner Rodman Wanamaker. The future winged policemen are being taught the intricacies of aircraft and the workings of engines with actual machines, and a complete radio course is part of their "ground work." Some of the instructors are members of the Police Department, but none of the students in training are policemen.

The accompanying illustrations show members of the Aviation Division receiving instruction.



Copyright, G. V. Buck
Novel gunstock attachment for a German automatic pistol of the Mauser type



Copyright, G. V. Buck
German automatic pistol with a combination wooden holster and gunstock

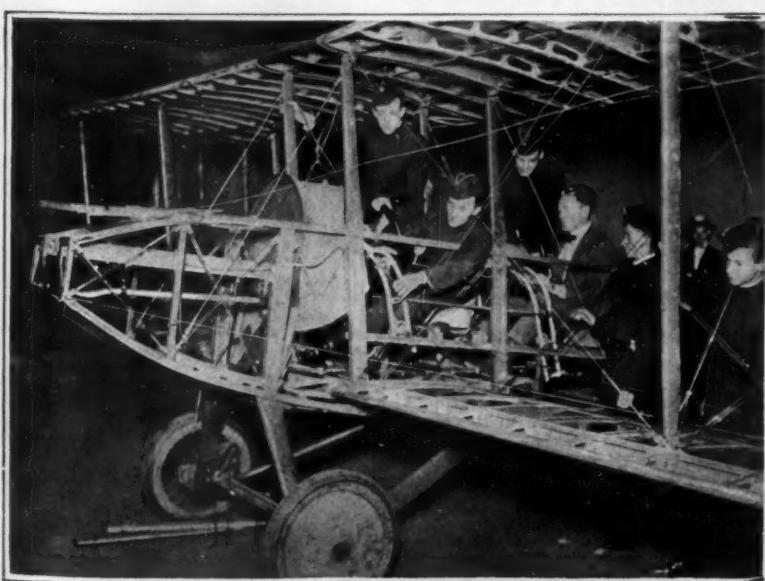
But with destroyers, converted yachts, and motorboats on the surface of the water, enemy submarines below the surface, and blimps and airplanes above, the German U-boat commanders have been having such a strenuous time of it, that they must look back with envious eyes to the days when patrol boats and air-



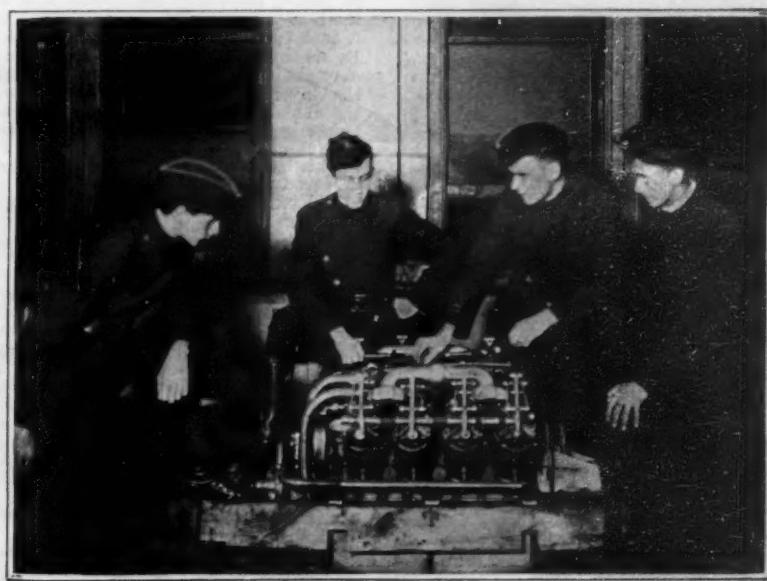
Italian Alpini grinding coffee for their company with the aid of a crude water-wheel

planes were scarce, and unarmed merchant ships were as helpless against the German pirates as a flock of sheep against a band of pursuing wolves.

A recent statement from the other side announced that recently a British and German submarine sighted each other, and played hide-and-seek for nearly half an



Members of the Aviation Division of New York's Police Training Corps receiving practical instruction



New York's future winged policemen studying the intricacies of a standard airplane engine

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A Home-Made Roller Truck

A NEW HAMPSHIRE farmer who built his house on a side hill for the purpose of securing a beautiful view was confronted with the task of grading so as to get a level front lawn and at the same time enlarge his back yard. This meant the moving of hundreds of tons of hardpan. As it was impossible for a team to navigate on the place at the start, while the use of the wheelbarrow grew to be tiresome work, he began to look for some way of making the work more interesting.

The motor roller truck, as he christened the result of his efforts, goes rightly by this name, as it is built on the plan of the big steam rollers for street use. The front wheels are close together, and the rear wheels track just outside of them, thus making a successful roller covering a width of 26 inches. The wheels, six inches wide and 16 inches in diameter, originally were cast-iron pulleys salvaged from the scrap pile. The frame is built of 2 x 3 hard wood, well braced with iron for heavy work. The truck is driven by a one-cylinder motor-cycle engine which is geared down to run the truck at a speed of two miles per hour. This gives sufficient power to haul 1,500 pounds of dirt at a load. The truck is equipped with a forward and reverse lever that makes it possible to back up to the edge of the bank and dump the load. The engine, which is directly under the seat, is air-cooled by a fan running twice as fast as the engine itself. This fan is visible in the picture that shows the body tipped up.

The truck is 2 feet wide, 8 feet long, and about 3½ feet high, making it possible to travel in a very small space. A two-gallon gasoline tank is visible above the machine. The camouflage radiator makes a striking effect at first sight. The owner states that his home-made contrivance has changed the work of grading from a task to a pleasure, and that in addition, it excites a great deal of curiosity, alike among natives and visitors.

A Variable-Pitch Fan for Regulating Engine Temperatures

A GOOD deal has been said about the variable demands of the radiator, and the impossibility of meeting them without special equipment of some sort. If the amount of cooling surface is right for a speed of 30 miles per hour, with the thermometer at 70 degrees, it will be too great or too little at different speeds and in different weathers. And similarly, if the circulation of air or water is just right today, it will be wrong tomorrow, and the engine will get too hot or too cold.

One way to attempt adjustment of the



A home-made motor roller truck

matter is, of course, to have some means for putting into action more or less of the radiator, as circumstances demand. Perhaps a better expedient is to speed up or slow down the current of the cooling medium. If the car is air-cooled, the device illustrated herewith seems to afford an excellent means of accomplishing this result.

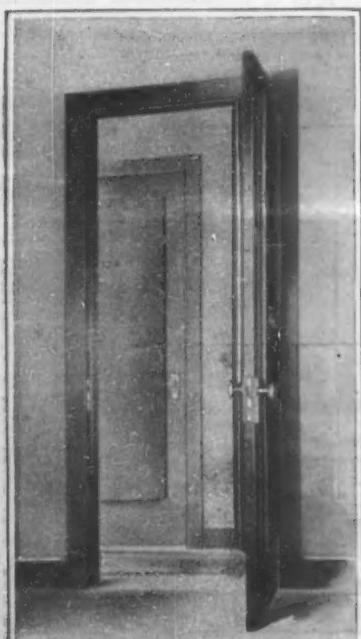
In general terms, what we have here is a fan for blowing air through the radiator—and a fan whose blades are of variable pitch. When we want more or less air, we simply adjust these blades to a sharper or flatter angle, and the trick is done.

The mechanism by means of which the blades are turned is interesting, and is readily understandable by a glance at our drawing. Each blade A is rigidly fixed, at its base, upon a circular pillar attached to a crank arm B. The handle of this arm fits into the interspace between the two leaves of the double circular disk C, being held in place by a small peg. Through the center of the double disk passes a rod D, held securely at the one end by the lever system F and at the other by a spring E. By moving the lever, the rod D is thrust in or pulled out; and the disk C must follow. This motion, however, carries the crank handle B with it; and as this handle moves up or down, out of the plane of the paper in our small framed insert, the whole crank turns, and with it of course the fan blade. So pulling the rod D out rotates each of the blades in one direction, and pushing it back turns them in the opposite sense. By means of the connection F the thing may obviously be made to operate from the driver's seat; so, within the limits of the fan's capacity, the engine can no longer get too hot or too cold. The skillful driver will know just where to set his fan blades for every combination of speed and weather in order that he shall have just the right amount of engine cooling.

Something New in Doors

FOR the purpose of affording privacy and seclusion to guests, each guest room of New York's newest and largest hotel is to be equipped with a unique door, the invention of Mr. Franklin J. Matchette. The door is full length, fire-proof, simple in operation, and serves many purposes besides egress and ingress. There are really two doors combined as one, forming a cabinet or receptacle; one door opens into the guest room, the other opens into the corridor. An automatic locking device prevents both doors from being open at the same time, making it impossible for anyone to enter or to see into the room through the door.

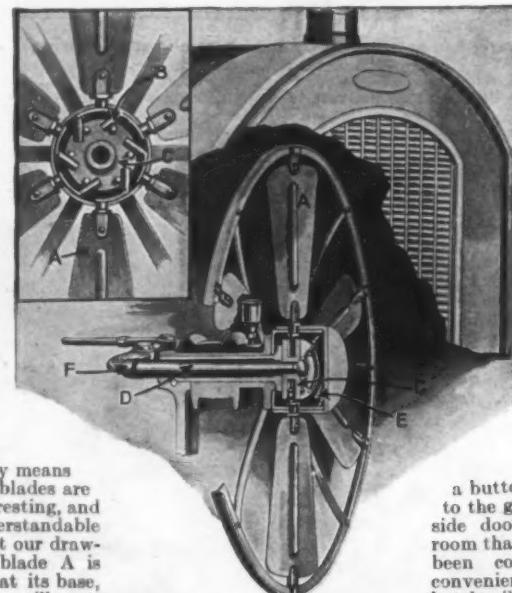
Each door has a swell front allowing



The service door, showing thickness of the internal compartment



Using the roller truck as a dump cart



The fan with blades of variable pitch, showing the mechanism which controls their position

a button which signals to the guest on the inside door of the guest room that the service has been completed. For convenience of guests the hotel will carry a stock of small standard articles, each listed and numbered, and contained in a book kept in the room. No extra charge will be made for this service and the prices for such articles will be the same as if purchased elsewhere. The new door prevents needless intrusion into the room, does away with door knocking, door tending, and other disturbing interruptions incident to ordinary hotel rooms.

In addition to the invisible, silent service, ventilation of the room is made complete by an opening at the top and bottom, equivalent to a 12-inch round hole, which permits of a free circulation of air, and eliminates the objectionable transom. The ventilator openings are controlled by push buttons located above the door knob of the inside door, each opening being light- and sight-proof and nearly sound-proof. In this way the light and noises from the corridor are done away with.

When used in apartment houses this double door permits deliveries of household supplies without disturbing the occupants while they are engaged or absent. The grocer and butcher, having keys to the outer panel, place their wares inside, where they remain until taken out by the occupants of the apartment.

Machinery in the Household

TWO sharply opposed tendencies in household economics have recently been developing. The burden of "keeping house," of being employed in the manifold duties of cooking, cleaning, washing, and what not, has become more irksome to the modernized woman, while the difficulty of engaging and retaining "help" to assist in these duties has also grown apace. Thus, with the greater distaste for the work has grown the requirement that the mistress of the house take on a larger burden of it. The so-called servant question has become more and more

acute and this tendency will be accentuated rather than diminished if present signs are of any significance. Apparently some radical reorganization in the social structure will be necessary to accommodate itself to these changing conditions. This reorganization will probably be partly social, involving changed methods of living, different relations between employer and employee, and greater tendencies toward co-operative efforts; and partly mechanical, utilizing means embodying new devices for cooking, cleaning, general kitchen work and the transfer of material.

Dismissing for the present the question of social reorganization, which is a large and complex subject, involving many unseen factors, and meriting separate treatment, and taking up the more obvious aspects of the deficiencies in household economics, it is plain to see how far behind the age, as expressed in industrial channels, is the domestic situation. The general lack of labor saving devices, and the omission to substitute machinery for manual labor are the outstanding features of most households. Especially is this true of the kitchen, where drudgery work at its worst is performed. It is true of course that the advent of the vacuum cleaner, the fireless cooker and the electric heater has ameliorated hardships to an appreciable degree, but these are independent utilities and are not co-ordinated with any general scheme. These utilities, while they lighten the burden, do not solve the problem. Particularly irksome, is the frequent dishwashing, the scrubbing of pots and the scouring of pans. Devices there are for this special service, but the kitchen lay-out is not arranged for proper co-operation, nor is the operation of scouring effectively performed by this utility.

The driving necessity of a drastic change in the domestic service situation is bound to operate in the devisement of remedial measures. In the last few years, every department of the household service has seen installation of mechanical expedients to lessen labor and increase efficiency, but the structure of the house is rarely involved, there is generally an absence of co-operative equipment by which these independent utilities may be made most serviceable and co-ordinated, and in thousands of households in this up-to-date land, the various steps of domestic duties are performed in the time-honored, drudgery fashion of generations ago.

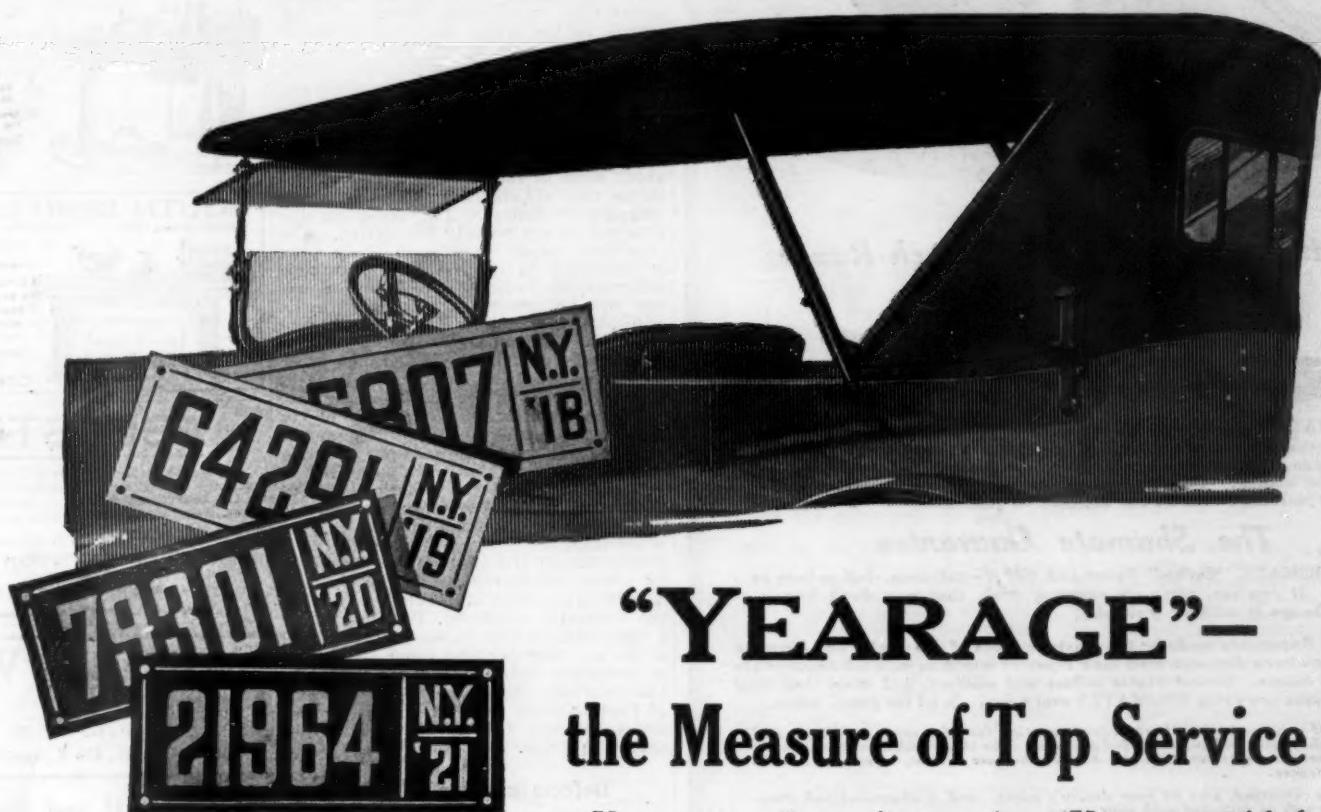
Apparently, the solution of this modern and pressing problem must come through a greater measure of co-operative effort, through the installation of some central

(Concluded on page 219)



The service door in action, seen from outside the room

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of Cigarettes

The Current Supplement

IT is generally recognized that there will be many radical changes in the world commerce as soon as hostilities in Europe are terminated, and every commercial body in the world is keenly studying the problem and preparing for the future. In fact, as soon as the fighting with weapons ceases in Europe, a war of wits, involving every nation in the universe, will begin. In view of this situation the article on *Problems of the Pacific*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2228, for September 14, will be found a valuable contribution, from a foreign source, as the region involved is one of the most important on the map, for many reasons. To the public, shipbuilding appears to be just a big rough-and-ready job that only requires lots of material, lots of men and plenty of muscle; but there is a lot of it besides pounding on iron. The article on "Laying Down" a Ship tells about some of the preliminary work, and shows that shipbuilding is really a very complicated matter. The accompanying illustrations are broadly instructive. The important paper on *Modern Aeronautics* is concluded in this issue. One of our indispensable luxuries is coffee, so everyone will be interested in the article on *Sidelights on the Coffee Industry*, which is from the pen of an authority, and is illustrated by unusual photographs taken on the spot by the author. Most of us now know how indispensable potash is to the world, and what a monopoly of the material Germany holds. The article on *New Potash Deposits* surveys other sources of supply that may be looked to partially relieve the situation. *Wake-Stream and Suction* considers problems of importance in the handling of ships, and is accompanied by some diagrams. *The Preparation of Helium* describes a method by which this highly interesting chemical element is prepared, and there is a sketch of the apparatus employed. *The Blue Sky* is a discussion of the reasons for the color of the sky, together with other phenomena of molecular diffusion. Other articles in this issue are: *Anthropology as a Corrective of Provincialism*; *A New Method of Creosoting Lumber*; *Cost of Carriage of Passengers in Ships*.

Defects in Airplane Woods

(Concluded from page 212)

from the severe shock when the tree is cut down. They constitute a very serious defect and are fairly common in spruce and mahogany and may appear in any wood that is somewhat brittle. In mahogany there is usually enough discoloration to make the break conspicuous, but in the case of spruce very careful inspection is necessary. In a soft wood, too, the matter is sometimes complicated by superficial fiber breaks made by the planer knives, but these can usually be recognized by their regularity.

Splits or shakes of any nature in wood are elements of weakness. Sometimes these occur in the living tree but more frequently result from irregular shrinkage in drying. If drying proceeds too rapidly on the outside the outer layers of wood contract and stretch about an unyielding core, and many of the fibers are torn apart. Wood also dries very fast from the ends and if these are unprotected, numerous splits will open up. Later when drying is complete, many or all of these checks may close up and become invisible, but the lateral continuity of the wood fibers is broken and the strength materially reduced. The effect is most serious when a cross-grained member is subjected to a bending stress. The best cure for season checks is careful attention to all stages of the drying process, from the living tree to the kiln-dried lumber. The modern methods of kiln-drying give better results with green lumber than the air-seasoning methods until recently considered the best.

If drying is not properly done wood will case-harden and be full of unrelieved strains which are likely to cause a manufactured article to get out of shape. Before the wood leaves the dry kiln tests are made to detect case-hardening. Sections of sample boards are ripped through the middle and their behavior noted. If the boards remain flat the material is in good condition, but if case-hardening exists the thin boards will cup or bow from or toward the saw, depending upon whether case-hardening is in the first or the final stage. Case-hardening is overcome by a sort of annealing process in which the wood is rendered plastic by steaming for a short time and then re-drying.

Pitch pockets in coniferous woods are local cavities between growth rings which become filled more or less completely with hardened resin. They are difficult to detect until opened up in manufacture, unless large enough or near enough to the surface to distort the grain. They are elements of weakness but their seriousness in any particular case depends upon their size, number and location.

There are various other defects in wood, some of them the result of growth, others due to external agencies. In mahogany it is not uncommon to find large reddish

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streaks composed of short, brittle cells with little strength. Such portions should always be eliminated. "Black dots" is frequently met with in yellow poplar and may be merely a stain which does not affect the strength, or incipient decay which does. Sapstain does not weaken unless it is in advanced stages. Holes made by worms, borers, teredo, etc., reduce strength in proportion to their number and size. They are often accompanied by decay.

Where various kinds of woods are being used on the same operation the question of identification becomes important. Sometimes it is a question of excluding a certain species entirely, again merely in measure of precaution against indiscriminate mixing. Philippine mahogany, for instance, is not permitted in the combat type of propellers, and the inspectors and manufacturers frequently are at a loss to separate this material from genuine mahogany. While the general appearance and feel of the wood are usually enough for a person familiar with them, need is often felt for some definite characters which can always be relied upon in cases of doubt. It exists in the form of resin ducts which are distinct on a smooth end of a specimen individually if a hand-magnifier is used, collectively without it. To the naked eye the end section appears marked with narrow white lines, some long, some very short, and mostly without any regularity of spacing. With the lens these lines resolve themselves into rows of white beads, each bead corresponding to the cross-section of a resin duct. With very little practice anyone can "spot" Philippine mahogany as quickly as he can smooth the end with a sharp knife and apply the lens.

Philippine mahogany is not the name of a tree but a trade term for a group of closely related woods. It corresponds exactly to our use of the term "southern pine" to designate the wood of any one or all of five different species of pine which grow together in the South. And just as these southern woods intergrade and are separated commercially on a basis of quality, so in the case of Philippine mahogany. The writer has attempted, so far in vain, to find some specific characters which are constant, but the individual variations seem to cover as wide a range as those of different species. Hence it seems safe to follow the present practice of classing the softer and lighter grades as red lauan and the harder, stronger material as tangue.

Another problem is the separation of the African and the tropical American mahoganies. Although these woods are both acceptable, it is not considered good practice to mix them in a propeller. Here again the ends of the boards tell the story, this time so the casual observer may read.

Narrow white lines which appear as though marking rings of growth, sometimes close together, sometimes widely spaced, will be found in every piece of true mahogany from tropical America, but not in that from Africa. At least the writer knows no exception to this statement.

If these lines are examined with a lens they will not show the beaded or dotted nature previously described for the Philippine substitute. Some of the harder grades of genuine mahogany have some of the pores filled with lime deposits but they are irregularly scattered instead of collected in tangential rows or concentric rings. More commonly the pores are plugged with reddish gum masses and as these are absent in the Philippine material they furnish additional aids in identification.

The so-called "practical" man is inclined to look upon these methods as needless refinement, but the large number of cases of mistaken identity of woods used in propellers which have come to the writer's notice emphasizes the need of some refined methods. The fact that wood is variable should serve, not as an excuse for careless selection, but as an incentive for more thorough analysis of its properties. Only those who know woods intimately can use them with discrimination.

The Government's Emergency Construction Contract

(Concluded from page 213)

into the scheme of things and the Government places itself in a position to carry out its larger policies in regard to these matters without let or hindrance from the contractor; in other words it maintains its control of its own work.

The proof of the pudding is in the eating and one naturally inquires how the contract has worked out. The answer is that it has worked out very well. It has been applied uniformly on over three hundred and fifty contracts involving over \$500,000 worth of work and the consensus of opinion among people who know is that it has been more than a success. This is not an assertion that it produced 100 per cent efficiency. Consider the changes, backing and filling, the tearing down and building up, and the violent eruptions that have beset the building program. This was discussed in the last article as recited by the Construction Division to the Committee

that was appointed to look into the matter. Consider where the Government would have stood on a bidding proposition under those highly disturbed conditions.

The report of March 15th of that distinguished Committee may here be quoted in part. After reciting their careful examination of all the possible forms of contract, they have this to say:

"Having advised therefore that these various forms be not used, and for the reasons stated, the Committee unanimously concurs in advocating what may be termed the cost plus a sliding scale fee scheme of contract for both general contracts and subcontracts. In its general application it enjoys the same confidence in the building world as to the equities as does the lump sum contract, as is evidenced by its very extensive use. Its essential features are its applicability to projects great and small—its extreme flexibility with automatic adjustment of all variations in plan and scope. Under its terms the rates of pay for labor are known to be more equitable than under other methods—it requires for its successful application a painstaking review of the records, and standing of contractors, just as is now made under existing methods to insure the selection of an organization which measures up to the requirements of the contemplated project but without working any hardship, since no one can escape the axiom that in the final analysis each job can go only to one contractor. The Committee believes that one of the objections charged to this form of contract is that it encourages extravagance and holds open temptations to increase costs because such increase is accompanied by increased compensation. The general form of contract now in use by the Cantonment Division in which the percentage decreases as the cost increases and is broken by fixed fees at intervals seems calculated to effectually check, if not prevent, this tendency. Moreover, under the contract proposed the Government retains the right to control the prices of most materials and of labor. Under these circumstances it does not seem to the Committee that such an objection would have any force in relation to this form of contract. No reasonable objection can be pointed out by anyone possessing a full understanding of its equitable operation in practice, and finally this scheme appeals to the Committee as possessing one qualification which must commend it to all thinking men—it permits starting actual work weeks and even months before the details are completely worked out and delineated and permits the Government to push the job at any speed it may elect, changing at will its plan and scope but paying only what the work actually costs plus a fee which is so reasonable as to be above the reach of fairminded criticism.

"The Committee therefore advises for emergency construction work by the Cantonment Division the scheme of contract known as 'cost of the work plus a sliding scale percentage with a maximum upset fee.'

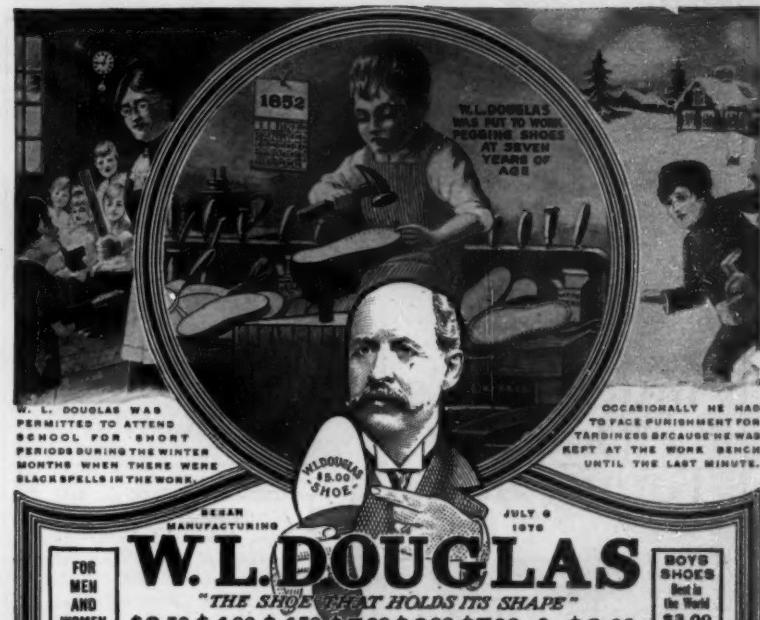
The building industry knew that an unprecedented condition would have to be met—one that would rock the economic structure of this great country to its very foundations—\$500,000,000 worth of structures to be undertaken within a year with every operation starting the minute it was approved and before any but the most meagre and hastily studied plans were available.

The next article will discuss the organization of the Construction Division—the administrative and supervisory organization of the Government that has so splendidly carried out their part of the work. Their case was not like that of the boy who, by sticking his finger in the hole in the dike, saved the trickling leakage from eroding away the mighty structure. On the contrary they were like those we may have read about who, hearing of the approaching avalanche, quickly organized, reached out, and grasped the resources that were available and stemmed the onrushing mass. With the aid of the contracting industry, the Division has in a very great measure stemmed the avalanche of waste that otherwise would have been not only uncontrollable, but which might have swept away the very structure of our war preparation itself. The form of contract devised by the War Industries Board, in the hands of able contractors, has been one of the principal factors in the success of the Construction Division in bringing the vast building program through on time.

Machinery in the Household

(Concluded from page 216)

service plant, wherein larger units may be utilized, expert assistance employed, and mechanical appliances for saving labor and transfer of materials be taken advantage of. It would be interesting to surmise in what guises these chances may appear and to endeavor to picture their possible details. It is certain, however, that the old order is passing, and that we are at the threshold of a revolution in domestic operations comparable to the advance made in the industries in the utilization of machinery and the forces of nature.



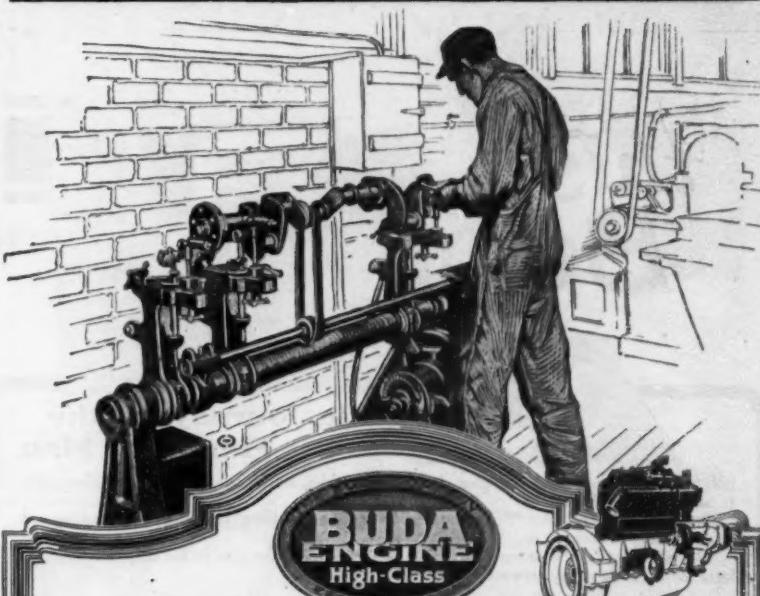
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It was inevitable that Miss Kellerman should write a book, and quite to be foreseen that manifold photographic representations of the author should make it a beautiful book; what those who knew the author only from across the footlights could not foresee was that it should be such a decidedly good book. While Miss Kellerman, first and foremost a swimmer rather than a diver, a dancer, or a film heroine, gives unimpeachable instruction in swimming and diving, there is nothing she can say that has not been said by many others before—although she has a distinctly individual way of saying it. What is unique is the first part of the volume, the story of her swim to fame and fortune. Here she is delightfully naive and perfectly frank—even to divulging the century of her birth. Her crippled childhood, her cure by swimming, her early triumphs in Australia, her attempt at crossing the English Channel, her vaudeville experiences, and the thrilling incidents of her picture work, are described in so human and feminine a way that lovers of the water, the moving picture, and human nature will all find themselves smiling as they go from page to page. Her enthusiastic plea for swimming as a means of attaining beauty, health and safety will lead many to take up her instructions where the dry directions of others have left them unmoved to persistent effort.

COAL CATECHISM. By William Jasper Nicolls, M.A.M.S.C.U.E. Philadelphia and London: J. B. Lippincott Company, 1915. 12mo.; 250 pp. Price, \$1.50 net.

Back in the Middle Ages, science had its catechisms, and for certain purposes the method of question-and-answer has never been improved upon. The layman who wishes to inform himself on the subject of coal, from its geology and geography to its transformation into that heat, light and power which are the bases of our present wealth and civilization, may first assimilate the short, sharp, paragraphic answers; he may choose only special chapters, such as those on transportation and shipments, or he may conscientiously attack the twenty chapters one after another; he may then test his retentive powers by reading the questions and seeing how near his own answers come to those of the catechism. In this way the busy man can make the most of brief periods of leisure and acquire solid knowledge of a vital subject that is now more than ever putting forth insistent and compelling claims on our attention.

THE NAVAL CONSTRUCTOR: A Vade Mecum of Ship Design for Students, Naval Architects, Shipbuilders and Owners, Marine Superintendents, Engineers and Draughtsmen. By George Simpson, Member of the Institution of Naval Architects. New York: D. Van Nostrand Company, 1918. 12mo.; 894 pp.; illustrated. Price, \$5 net.

The fourth edition of this much-used handbook appears in the nick of time, when its enlarged aid to those who are striving to throw a bridge of ships across the Atlantic will be increasingly appreciated. It discusses all the important points of the theory and practice of marine architecture and includes much that will not readily be found elsewhere. Among noteworthy features are the chapter on design, the tables of standardized fitting details, the explanation and simplified application of the freeboard tables, and added material such as the details of unit offsets for a variety of vessels, steam heating as applied to ships, and much other original and highly useful information. For so compact and handy a volume, its scope and comprehensiveness is amazing; this result is made possible by the elimination of the obsolete and antiquated, and by a conciseness of treatment that has not sacrificed simplicity of wording, but is always perfectly definite and intelligible. Ship calculations, strength of materials, fittings, rigging and equipment are all treated with a scrupulous finality and wherever possible accurate drawings and charts are made to take the place of wordy description.

THE MODEL T FORD CAR, TRUCK AND TRACTOR CONVERSION SETS. By Victor W. Page, M.E. New York: The Norman W. Henley Publishing Company, 1918. 12mo.; 312 pp.; illustrated. Price, \$1. Many of the owners and operators of this most popular make of car will welcome an instruction book so complete that guesswork is eliminated. With every part of the car illustrated and described, with essential principles thoroughly set forth and the sources of trouble and its remedies clearly put before the reader, even the man of very limited mechanical knowledge may quickly learn the construction and possibilities of his car and the means of correcting any difficulty that may arise. In his well-known and comprehensive treatise on "The Modern Gasoline Automobile," Lieut. Page brought the instruction book to a perfection that will be exceedingly hard to equal, let alone surpass, but such a general discussion can of necessity concern itself but briefly with particular makes of cars and engines; here his own first hand familiarity with the Ford car is shown in the way in which he cuts to the quick of every problem of maintenance and repair and throws open to the reader every point of his own experience and study. This car is frequently converted into a truck or tractor by the use of certain attachments for the purpose, and these converters, as well as the Ford farm tractor, are carefully described and pictured in the text. The special photographs and drawings are a striking feature of the work, and make it impossible to mistake the meaning of the text or to misapply the instructions given.

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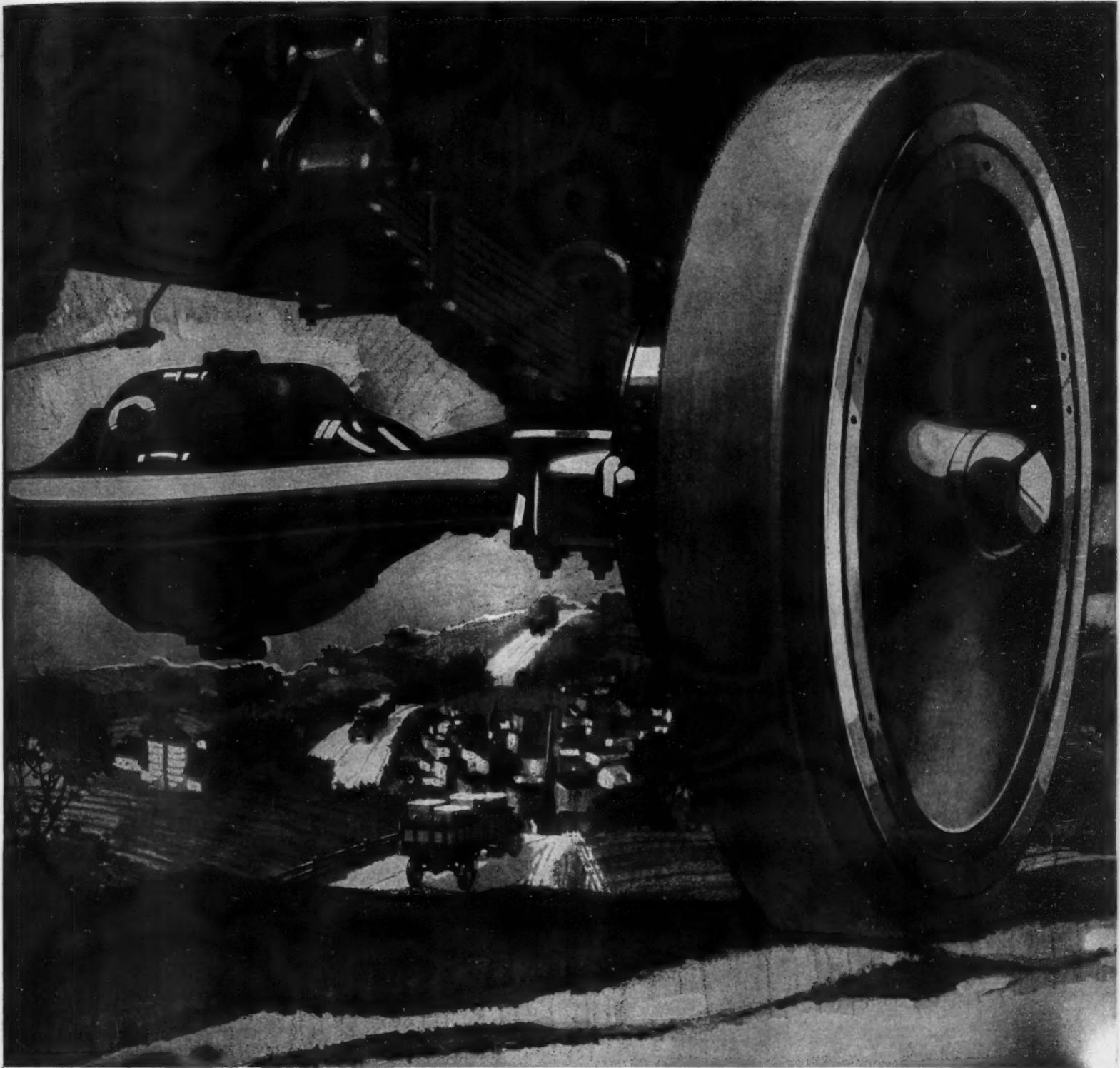
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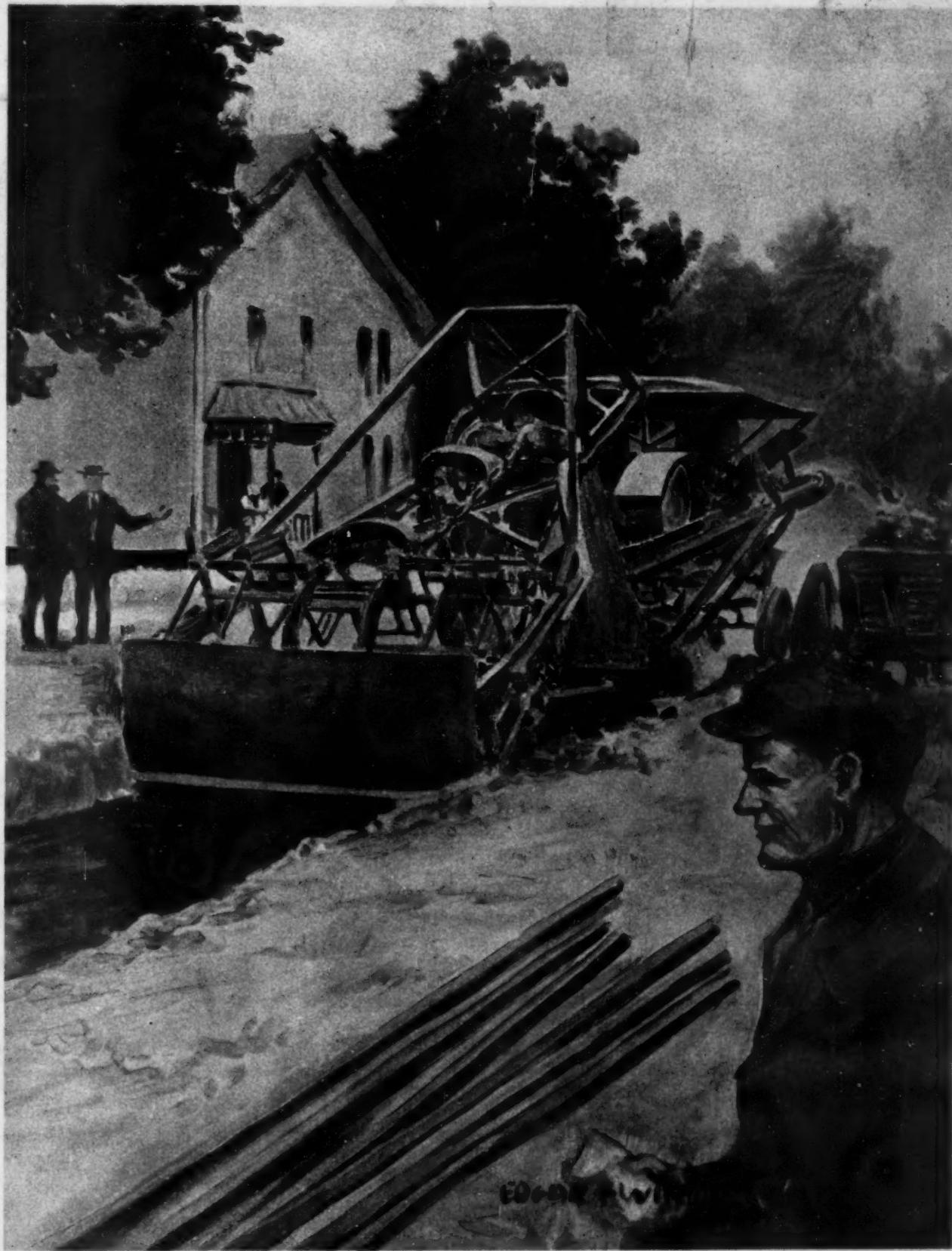
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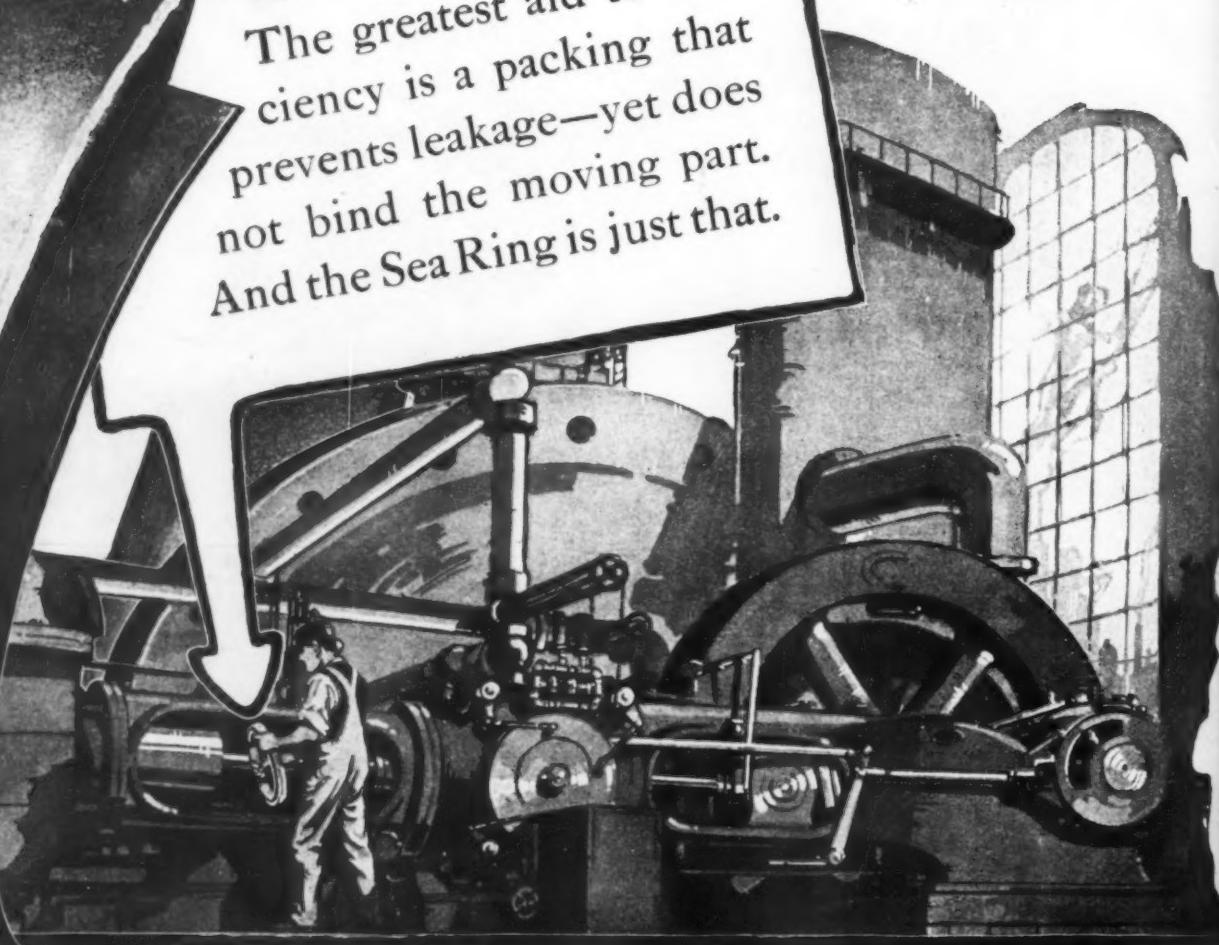


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6. Sea Rings provide for standardization because suitable for nearly all conditions where rod packing is necessary.

A Complete and Standardized Packing Line. "Sea Rings" that prevent leakage, yet avoid friction. "Universal" for inside packed pumps, a folded fabric packing that cannot pull apart. "Kearsarge Gaskets" that stand up under removal wear and tear. "Service Sheet" as good on super heat as on cold water. "Mogul Coil," for small packing spaces or where because of oil or acid, rubber would be worthless.

This booklet, "Fuel Waste in the Power Plant," send free to plant owners and operators. It suggests many simple and effective measures for the reduction of preventable waste, that are commonly overlooked in the operation of power plants and factories. Write for your copy.

H. W. JOHNS-MANVILLE CO. New York City 10 Factories—Branches in 61 Large Cities



For Meeting Emergencies: The Pierce-Arrow Motor Truck

OWNERS find Pierce-Arrows always equal to emergencies. A recent instance illustrates this strikingly.

Failure of a pump threatened to shut down a Norristown electric light plant. A new pump could be obtained only from the Westinghouse plant at Pittsburg. An embargo prevented freight movements from Pittsburg east. But the pump must be moved.

John Battenfield agreed to deliver it in three days.

His 5-ton Pierce-Arrow truck started at noon Saturday and reached Ligonier, 53 miles, by 5.30 P. M. Sunday he crossed the Alleghany Mountains to McConnellsburg, 85 miles. Monday it ran to Lancaster, 106 miles, and on Tuesday covered the remaining 65 miles to Norristown before noon.

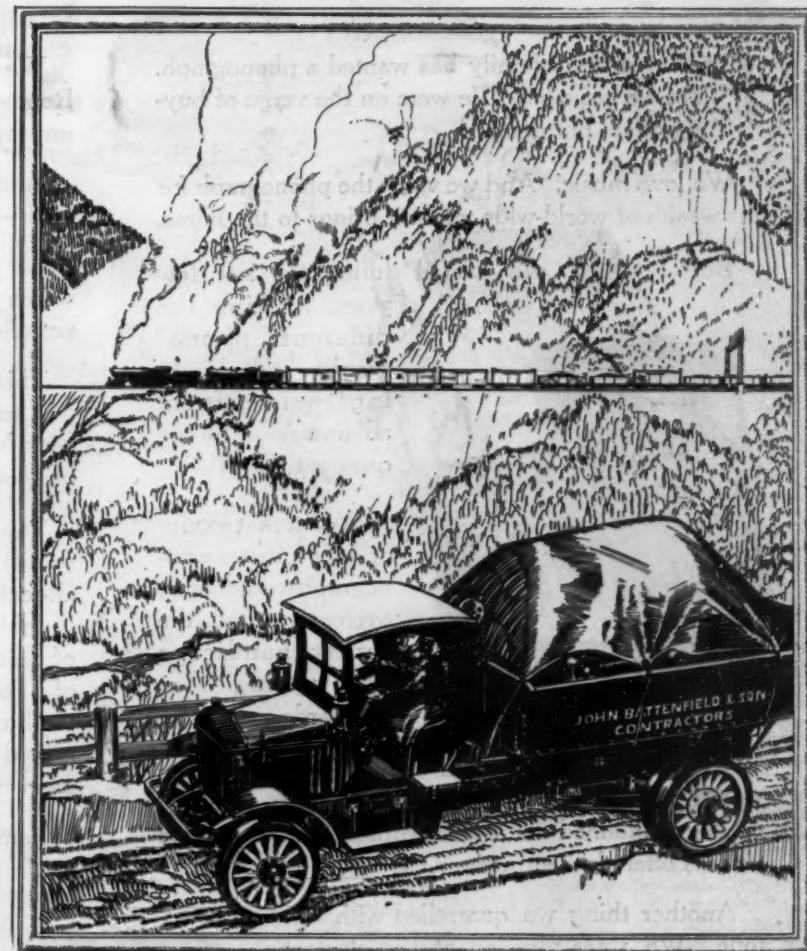
Some years ago, these mountains were chosen for the severest tryouts of touring cars in testing.

With another 5-ton load he started from Norristown, Wednesday and ran 105 miles to York. Thursday he covered 116 miles to Bedford and on Friday the remaining 95 miles to Pittsburg.

The six-day round trip, with full loads meant 90 hours actual running time, and an average speed of 7 miles an hour over mountain roads. The operating cost was exceptionally low, but the service, avoiding the shutdown of a public utility, was worth any price.

This truck has served Battenfield since November 1916. It usually carries builders' supplies, hauls 20 to 30 tons daily and has run over 25,000 miles. It has been out of service 2 days in 2 years.

Many Pierce-Arrows in many businesses render equally notable service.



PIERCE-ARROW reputation is due to this:

- It delivers more work in a given time;**
- Loses less time on the job and off the job;**
- Costs less to operate and less to maintain;**
- Lasts longer, depreciates less and commands a higher resale price at all times.**

Superior speed saves many hours and enables Pierce-Arrows to deliver more work, lowers operating costs and multiplies earning capacity.

Sound design, the best materials and workmanship keep Pierce-Arrows out

of the repair shop, saves time and reduces maintenance costs. Regular inspection contributes to this end.

No one can say how long Pierce-Arrows will last. None has worn out. After 7 years the first 50 Pierce-Arrows are good for many more years. Each has run 75,000 miles, some double that. This accounts for their small depreciation and the high resale prices they command.

PIERCE-ARROW

The Pierce-Arrow Motor Car Company, Buffalo, N. Y.

"Why I Chose a Brunswick"

By BURTON WYNNE

Adventures in Seeking the Super-Phonograph

FOR years my family has wanted a phonograph. Yet we hesitated. We were on the verge of buying often, but delayed.

We love music. And we value the phonograph for the wealth of world-wide talent it brings to the home.

But frankly, we waited during the last few years, hearing the different phonographs and weighing their different advantages—never quite satisfied.



We felt that sooner or later a better phonograph would come, overcoming all the current handicaps and setting new standards.

We never liked the idea of a phonograph which would play only its own make of records. No one catalog contained all our favorites. Each line of records offered its attractions.

Another thing we quarreled with was tone. We were repelled at the strident tones of some. And others seemed to be nearly perfect, but not quite.

I realize that all this sounds like we were too critical and that we set ourselves above the thousands who were content with the phonographs we hesitated to buy.

But we wanted to be sure before we bought, so as to avoid regrets.

In our determination to find the super-phonograph, we came upon the new Brunswick. It was announced as something different, something advanced.



We read and heard of the Brunswick Method of Reproduction, which included the Ultona and an improved amplifier.

And so we investigated. We were somewhat skeptical—but we came away as proud owners.

For here, at last, was our ideal instrument—one which played all records at their best, one with incomparable tone.

This remarkable instrument ended our search. We found in the Brunswick Method of Reproduction all we had looked for and more.



The Ultona is a simple, convenient all-record player, adjustable to any type of record at a turn of a hand. And now we buy our records according to artists rather than make. Thus we overcome the old-time limitations.

I am convinced that the tone of The Brunswick is far superior, and due chiefly to the strict observance of acoustic laws.

The tone amplifier is built entirely of wood, molded so as to give the sound waves full opportunity to develop. No metal is used in this amplifier, so there are no stunted, metallic sounds.

My advice to every music lover is to hear The Brunswick before deciding. One's ear immediately appreciates the difference. And old conceptions of the phonograph are changed.

Brunswick dealers everywhere are delighted to play the new Brunswick for you and to explain its betterments.

THE BRUNSWICK-BALKE-COLLENDER CO.

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Branch Houses in Principal Cities of
United States, Mexico and Canada

Canadian Distributors, Musical Merchandise
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The Brunswick
ALL PHONOGRAFPHS IN ONE